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THE EFFECTS OF REVERSING SLEEP-WAKE CYCLES ON MOOD STATES, SLEEP, AND FATIGUE ON THE CREW OF THE USS JOHN C. STENNIS

by

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June 2004

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This study investigates the effects of reversing sleep-wake cycles on mood, sleep, and fatigue of the crewmembers and Air Wing 9 of the USS JOHN C. STENNIS (CVN-74). It also reviews the research conducted in sleep deprivation, circadian rhythms, shiftwork, fatigue, and mood. The effects of reversing sleep-wake cycle on mood of the crewmembers were analyzed by assessing a repeated administration of the Profile of Mood States (POMS). Mood states were monitored at three time points associated with the current work schedule (night shift vs. day shift) of the crewmembers. The results showed that younger participants were angrier than older participants on night shiftwork. The results also indicated that there was a significant interaction between repeated measures of mood states and gender. In addition, female participants reported significantly higher mood scale scores than the male participants, and topside participants were getting significantly less sleep than belowdecks participants. Given these findings, this area of research warrants further exploration. There is a significant need to educate military personnel of the effects of sleep deprivation and shiftwork on their job performance and individual health and safety.

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This thesis is dedicated to my uncle, John Dillard.
October 1, 1943 - June 3, 2004

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EXECUTIVE SUMMARY

The primary mission of crewmembers of the USS JOHN C. STENNIS (CVN-74) and Air Wing 9 was to sustain combat air operations during Operation Enduring Freedom. In order to support this mission, the crewmembers deployed two months ahead of schedule. Immediately, the Sailors were placed in an environment where their sleep-wake cycles were reversed. In any operational combat environment, decision-making and cognitive performance are essential components for success. These crewmembers were expected to sustain situational awareness in any type of tactical situation that occurred (Miller, Nguyen, Sanchez, & Miller, 2003).

In the laboratory, it is well understood that disrupted or insufficient sleep can cause deterioration in human performance as evidenced by slowed reaction times. For example, after 24 hours of sleep deprivation, the ability to perform mental work declines by 25% (Belenky, 2003). Even though simple tasks can be performed by a crewmember with a disrupted sleeping pattern, complex operations such as night flight operations require completion of complex tasks that include critical timing of responses. Sleep deprivation has been cited as the root cause of major accidents such as the Exxon Valdez oil spill, the Bhopal Union Carbide accident, and space shuttle Challenger tragedy (Rosekind et al., 1996). The United States Navy is not immune to these types of casualties.

Adequate sleep is essential for healthy living. The human body operates on a 24-hour synchronized biological clock. Once this circadian rhythm is disturbed, reaction times increase and mistakes are more likely to be made. Studies have shown that night shift workers and trans-Atlantic travelers have difficulties inverting their circadian rhythms (Kryger, Roth & Dement, 2000). During the night when the participants are mentally struggling to stay alert, their bodies are trying to follow normal circadian rhythms. It is natural for the human body to want to sleep during the night, and be awake during the daytime.

In this study, not only did the crewmembers of the USS JOHN C. STENNIS (CVN-74) and Air Wing 9 have to fight against their own circadian rhythms, they also

had to attempt to sleep during normal daytime ship operations. These factors may combine to have a negative effect on the mental state of the crewmembers. The Profile of Mood States (POMS) is a subjective test, based on a 65 five-point adjective rating scale, which measures six affective states: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia and Confusion-Bewilderment (McNair, Lorr & Droppleman, 1992).

Mood states were monitored at three time points associated with the current work schedule (night shift vs. day shift) of the crewmembers. The results showed that younger participants were angrier than older participants on night shiftwork. There was a significant interaction between mood state and gender with female participants reporting significantly elevated mood scale scores than the male participants. In addition, participants working topside received significantly less sleep than those working belowdecks and their POMS scores reflected their fatigued state.

The study provides vital information to the Naval surface warfare community concerning the operational impact of mood states and performance caused by extended working hours, disruptive sleep, and reversed/or sleeping cycles. There is a significant need to educate military personnel of the effects of sleep deprivation and shiftwork on their job performance and individual health and safety. The POMS results help identify relationships between physical and psychological changes as well as patterns, which may help in the prevention of other medical problems in the Navy's most valuable asset, its people.

I. INTRODUCTION

A. OVERVIEW

The primary mission of crewmembers of the USS JOHN C. STENNIS (CVN-74) and Air Wing 9 was to sustain combat air operations during Operation Enduring Freedom. In order to support this mission, the crewmembers deployed two months ahead of schedule. Immediately, the Sailors were placed in an environment where their sleep-wake cycles were reversed. In any operational combat environment, decision-making and cognitive performance are essential components for success. These crewmembers were expected to sustain situational awareness in any type of tactical situation that occurred (Miller, Nguyen, Sanchez, & Miller, 2003).

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they also had to attempt to sleep during normal daytime ship operations. These factors may combine to have a negative effect on the mental state of the crewmembers. The Profile of Mood States (POMS) is a subjective test, based on a 65 five-point adjective rating scale, which measures six affective states: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia and Confusion-Bewilderment (McNair, Lorr & Droppleman, 1992). The POMS was used to identify the mental states of the crewmembers during this heightened level of work.

The study provides vital information to the Naval surface warfare community concerning the operational impact of mood states and performance caused by extended working hours, disruptive sleep, and reversed/or sleeping cycles. The POMS results help identify relationships between physical and psychological changes as well as patterns, which may help in the prevention of other medical problems in the Navy's most valuable asset, its people.

B. AREA OF RESEARCH

The study is a follow-up investigation of the effects of reversing sleep-wake cycles on sleep and fatigue of the crewmembers and Air Wing 9 of the USS JOHN C. STENNIS (CVN-74). Building on previous work, this thesis will further analyze the sleep patterns of Sailors and will assess a repeated administration of the Profile of Mood States (POMS). The Profile of Mood States is a subjective test given to individuals to measure feelings and moods states. During **Operation Enduring Freedom**, countless night missions were performed as a part of regular duty. In order to better support this effort, the crewmembers had to shift from their regular day-shift schedules to night-shift schedules. The POMS tests were administered to the crewmembers in an effort to monitor changes in mood that could be associated with their current work schedule, i.e., night shift vs. day shift.

C. RESEARCH QUESTIONS

Primary Question:

What impact does reversing sleep-wake cycles of the Sailors aboard the USS JOHN C. STENNIS (CVN-74) have on their Profile of Mood States (POMS)?

Secondary Questions:

Is there a correlation between POMS results and amount of sleep received by Sailors?

Do factors such as working topside versus working belowdecks have an effect on the POMS results?

Do POMS results vary by gender or other demographic variables?

D. SCOPE

Twenty-four enlisted crewmembers aboard the USS JOHN C. STENNIS (CVN-74) volunteered to take part in this study. Throughout the duration of flight operations, each watchstander's responsiveness was crucial to ensuring the ship's mission was carried out successfully. Consequently, major efforts were taken to attract participants that represented watchstanders from different departments aboard the ship. The POMS was administered to the crewmembers after 30 days of "night shift work", then again 24 hours and 1-week after the shift back to a day schedule. This resulted in a total of three repeated administrations of the POMS for the twenty-four participants, all Sailors on the USS JOHN C. STENNIS (CVN-74).

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II. LITERATURE REVIEW

A. OVERVIEW

In today's society, people have adopted lifestyles that continually keep them on the go. "You snooze, you lose," is a common phrase for those who believe that you must sacrifice sleep in order to accomplish daily tasks. Unfortunately, for many Americans, work, social and recreation activities have taken priority over time for sleeping. To meet technological demands, operational and production rates have also increased, causing more Americans to steer away from the traditional working hours of 9 to 5. With a greater number of Americans working irregular hours, more people are exposed to sleep disruptions and have higher risks of developing sleep disturbances and disorders.

According to the American Medical Students Association, medical interns work up to 95 hours a week on a regular basis (McCartt & Rosekind, 2002). These authors further report that police officers on an average work 22.8 hours of overtime per month and commercial truck drivers can drive up to 10 consecutive hours before regulated to stop for rest. The Federal Aviation Administration's regulation allows airline pilots to work up to 16 hours per workday, which a maximum of 8 hours is allotted for flying. Furthermore, in many states physicians still do not even have a work-hour limitation. Without the proper amount of sleep, these individuals can cause risk to themselves and jeopardize public health and safety (McCartt & Rosekind, 2002).

Nearly 65% of the United States' adult population report that they do not get enough sleep; thus proving that boosting industrial productivity does not come without costs (National Sleep Foundation, 1999). In fact, the workers are being robbed of valuable sleep time by working longer hours in the workplace. As a result of severe sleep deprivation, humans make errors. It is estimated that U.S. businesses lose at least $18 billion each year due to human error (National Sleep Foundation, 1999). Some of the most catastrophic accidents like the Exxon Valdez oil spill, the NASA Challenger shuttle explosion, and the Chernobyl nuclear accident have been linked to sleep deprivation (Talk About Sleep, 2000). However, sleeping behind the wheel of a vehicle, the most common consequence of sleep loss, has become an increasing public health problem.

Reports have shown that one out of every three drivers will fall asleep behind the wheel at least once in their lifetime. Consequently, these sleepy drivers will cause roughly 100,000 crashes, 71,000 injuries, and 1,500 fatalities each year. These statistics however do not include "behind the wheel" operators, such as airline pilots, boat captains, and railway conductors (Talk About Sleep, 2000).

Military personnel may also endanger themselves and/or others if proper sleeping habits are not enforced. In any operational combat environment, military forces may be required to adapt to any type of tactical situation. In turn, the quantity and quality of sleep for military members is not likely to be a top priority. Since both decision-making and cognitive performance are essential components for success, the military has taken great interest in these issues.

In this chapter, normal sleep-wake cycles and circadian rhythms in humans are discussed. The scientific literature that is presented explains the importance of maintaining a steady sleeping pattern and the adverse effects to the sleep/wake cycle if sleep is disrupted. In addition, different shift work systems are discussed to show their correlation with an individual's adjustment to new routines. Other factors, such as fatigue and mood, will be introduced to show their importance to one's physiological and psychological state.

B. SLEEP

To sustain human survival, basic physiological needs must be met. These needs include food, water, oxygen, and sleep. Prolonged periods of sleep deprivation can cause brain damage and possibly led to death (Coren, 1996). The average amount of sleep required for effortless optimal performance and alertness is 8-8.25 hours (Neri, Dinges, and Rosekind, 1997). Some individuals may require a little less or a lot more, ranging from 6-10 hours. Not only is the quantity of sleep vital, but also the quality of sleep is important. Lack of quantity or quality of sleep can decrease or impair performance and alertness (Neri, Dinges, and Rosekind, 1997). A definite indication of sleepiness is when a person feels that they have to stay active in order to stay alert.

In 1894, de Manaceine conducted the first study on total sleep deprivation using animals. The dogs used in this experiment eventually died. Their autopsies revealed that

many of them developed small brain hemorrhages. Additional studies concluded that adult dogs die after 13 days of sleep deprivation, and puppies ordinarily die after six days of sleep deprivation (Coren, 1996). In January 1959, Peter Tripp, a New York disc jockey, stayed awake for 200 hours in order to raise money for the March of Dimes (Dement & Vaughan, 2000). Toward the end his "wakathon," he could not distinguish between a nightmare and reality. Tripp believed that he was going to be buried alive, so he frantically ran away from the doctors and the psychologist that were observing him (Coren, 1996).

Humans operate on a 24-hour biological clock that controls sleep patterns. During a 24-hour period, humans are usually awake during the day, and asleep during the night. The circadian rhythm, which governs sleep patterns, affects different physiological and psychological functions such as melatonin levels, alertness, body temperature, growth hormones, and cognitive performance.

1. Sleep Cycles

A complete eight-hour sleep cycle consists of two distinct states of sleep; REM (Rapid Eye Movement) sleep and non-REM sleep stages (McCallum, Sanquist, & Krueger, 2003). Some researchers suggest that REM sleep serves as a restorative function for the brain and non-REM sleep serves as a restorative function for the body (Reite, Ruddy, & Nagel, 2002). A full cycle of REM and non-REM sleep is approximately ninety minutes in length, which repeats throughout the sleeping period. Within a sleep cycle, a human progresses from Stage 1 through Stage 4 non-REM sleep to REM sleep. Then, the sleep cycle reverses back to Stage 4 through Stage 1 non-REM sleep. Throughout the REM and non-REM sleep stages, brain activity varies from stage to stage (Folkard & Barton, 1993). It is important to complete the entire 8-hour cyclic process of sleep to gain its full benefits. Insufficient sleep duration, alcohol, drugs, medication, and/or noise interfere with the physiological structure of the sleep cycles, which in turn impairs performance and alertness (McCallum, Sanquist, & Krueger, 2003).

a. Non-REM Sleep

Non-REM sleep is composed of four stages accounting for 75% of a typical sleep cycle. As a person enters Stage 1 sleep, they drift off to sleep. In Stage 1

sleep, low voltage brain wave activities are observed from an electroencephalogram (EEG) test and slow rolling eye movements are noticeable. An individual spends approximately 5% of their non-REM sleep in Stage 1 sleep, and can be easily awakened (Folkard & Barton, 1993).

From Stage 1 sleep, an individual transitions into Stage 2 sleep. Slowing heart rate and relaxing of muscle tension characterize this stage of sleep. Unlike Stage 1 sleep, brain wave activities of Stage 2 sleep become larger and eye movements cease. Stage 2 sleep makes up approximately 45% of non-REM sleep (Folkard & Barton, 1993).

In sleep Stages 3 and 4, it is more difficult to wake up an individual. These stages are associated with very deep and restorative levels of sleep. An individual is more likely to experience "sleep inertia," better known as grogginess and disorientation, up to 15 or 20 minutes, if they are awakened during these sleep stages. Approximately 12% of non-REM sleep is spent in Stage 3 sleep, and approximately 13% is spent in Stage 4 sleep (McCallum, Sanquist, & Krueger, 2003).

b. REM Sleep

REM sleep is recognized by low voltage brain wave activities similar to Stage 1 sleep. Because of these similarities, REM sleep is also known as "paradoxical" sleep. Many, but not all, dreams occur during this sleep stage. To prevent individuals from acting out their dreams, the brain blocks neural signals thus causing the muscles to remain immobile. Also, in this stage, periodic eyelid fluttering, muscle paralysis, and irregular breathing, body temperature, heart rate, and blood pressure are likely to occur. In a normal 8-hour sleep period, REM sleep makes up about 20-25% of the sleep cycle (Folkard & Barton, 1993).

2. Sleep Preferences

Individuals differ in the amount of sleep they require for optimal performance and alertness, and in the time they desire to go to sleep. Those that prefer to get up early are referred to as "Larks." Since larks usually get up early, they become sleepier earlier in the evening as well. "Owls" are those individuals that prefer to go to sleep late at night and get up later in the morning. Because of their sleep times, owls usually perform better in the afternoon and evening shift (McCallum, Sanquist, & Krueger, 2003).

3. Sleep Debt

The difference between the minimum amount of sleep an individual requires for adequate performance and the actual amount of sleep they obtain is called sleep debt (Chapman, 2001). There is a general slowing of mental processes with sleep debt (Coren, 1996). As sleep debt increases, the degradation of an individual performance also increases. The degraded performance may include slow reaction times, short attention spans, problems with short-term memory, and decreased problem solving and decision-making abilities (Chapman, 2001). As little as 2 hours of sleep restriction can significantly degrade performance (LeClair, 2001). A loss of 4 hours of sleep can reduce an individual's reaction time by 45% (Coren, 1996). Over a period of time, continuous sleep loss can build into a cumulative sleep debt. It is estimated that many adults in the United States lose approximately 1.5 hours of sleep per night during workdays. This results in an accumulation of 5 to 7 ½ hours of sleep debt built-up by the start of the weekend (LeClair, 2001).

A key feature of sleep debt is the cumulative build-up of sleep pressure. Continuous days of inadequate sleep result in 'chronic' sleep debt. In healthy individuals, chronic sleep debt occurs after extensive hours of voluntary wakefulness. In an effort to accomplish more tasks, these individuals sacrifice sleep for additional hours of wakefulness (Van Dongen, Rogers, & Dinges, 2002). Chronic sleep loss can contribute to obesity, diabetes, and, high blood pressure. Shift workers who experience sleep loss are more prone to have health problems such as gastrointestinal disorders, cardiovascular disease, and diabetes (Costa, 1996).

After a significant amount of sleep debt, an individual has uncontrolled sleep episodes called microsleeps. Microsleeps occur when sleep spontaneously intrudes into wakefulness. These episodes can occur even if an individual is actively involved in performing a task such as operating a piece of equipment (McCallum, Sanquist, & Krueger, 2003). It is common for microsleeps to occur when an individual is driving a vehicle (Rosa & Colligan, 1997).

A study conducted at the Walter Reed Army Institute of Research showed that volunteers who are sleep deprived for two days could significantly improve performance and alertness with high doses of caffeine and modafinal (Belenky, et al., 2002). In 1965, Dement and Gulevich monitored Randy Gardner, a San Diego high school student that set a world's record by staying awake for 11 days (Dement & Vaughan, 2000). During his period of prolonged awakenness, he showed signs of asteregnosis (difficulty recognizing objects using only the sense of touch), degraded physical coordination and strength, slurred speech, short attention span, and memory lapses. Tripp, the New York disc jockey, also experienced mood swings, hallucinations, and paranoia (Coren, 1996). Gardner fell asleep within seconds of his record and he slept continuously for 14 hours and 40 minutes. His sleep debt had accumulated to about 75 hours (Dement & Vaughan, 2000). This experiment demonstrated that sleep debt is not paid back uniformly. The myth that someone can catch up on their sleep on the weekend may be misleading since doing this may further disrupt the sleep wake cycle (Vedantam, 2002).

Sleep loss is not recovered in an hour-for-hour restitution. Recuperation takes place through an increase of non-REM sleep on the first night of regular sleep (LeClair, 2001). Another study conducted by scientists at Walter Reed Army Institute of Research showed that 3 days of recovery sleep still had not brought subjects performance to normal levels as shown in Figure 1(Belenky et al., 2002).

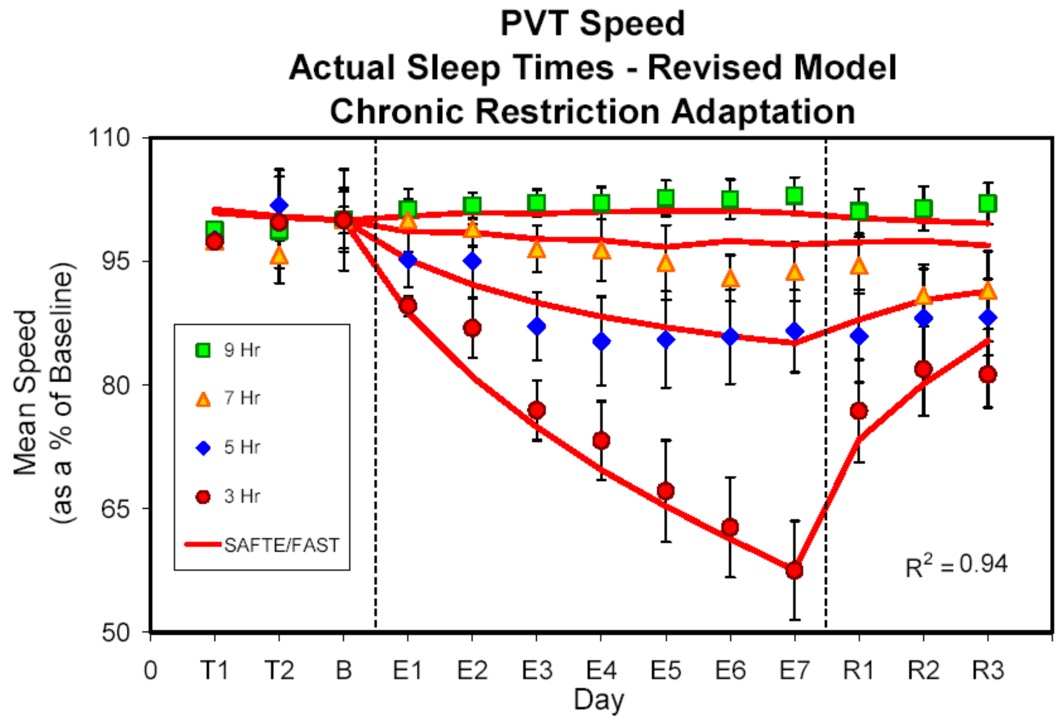

Figure 1. Sleep Response (Belenky et al., 2002)

C. CIRCADIAN RHYTHM

Numerous daily activities, such as sleep-wake cycles, hormone secretion, body temperature regulation, digestion, respiration, performance capabilities, and mood, are controlled by the brain's 24-biological clock. Circadian rhythm is a daily fluctuation in physiological and psychological functions controlled by the body's 24-biological clock. The term "circadian rhythm" originates from the Latin word *circa* meaning "about", *dies* meaning "day," and *rhythmus* meaning "recurrent alternation" (McCallum, Sanquist, & Krueger, 2003).

This "around a day" rhythmic clock is regulated by the suprachiasmatic nucleus or SCN. The SCN is housed in the hypothalamus part of the brain, right above the optic nerves cross point. The SCN contains 20,000 neurons that send signals throughout the brain. A signal is created and travels from the optic nerve to the SCN when light reaches the photoreceptors in the retina. The corresponding SCN signal then signals the pineal gland to switch off the production of the hormone melatonin (Kryger, Roth & Dement, 2000).

1. Melatonin

Melatonin is a hormone produced by the pineal gland. Elevated melatonin levels cause humans to feel drowsy (Kryger, Roth & Dement, 2000). As night falls, the body's levels of melatonin increases and an individual's body temperature falls, as shown in Figure 2. This increase in the production of melatonin along with a drop in core body temperature initiates sleep (Kryer, Roth & Dement, 2000) and results in a decreased level of alertness (National Sleep Foundation, 2004). During the day, it is highly difficult to detect melatonin in the body because the levels are so low. Individuals, especially night shiftworkers, attempting to sleep when their body's melatonin level is low and when their core body temperature has risen, have a difficult time trying to initiate sleep. If sleep does occur, then it may be in shorter intervals with more disruptions or awakenings (Kryer, Roth & Dement, 2000).

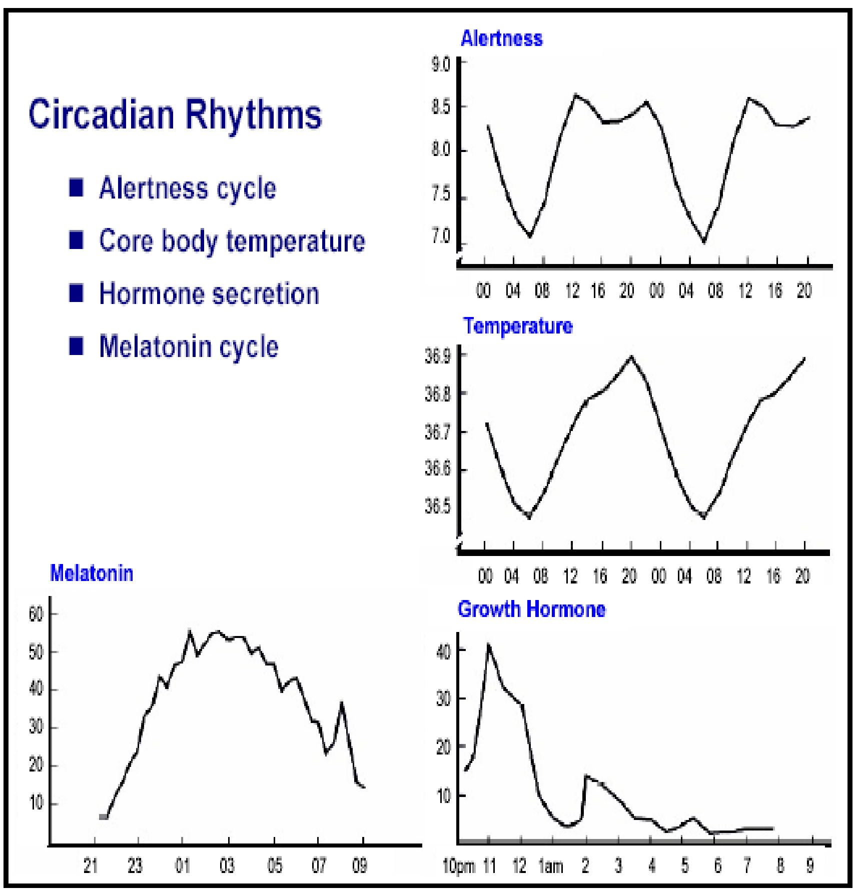

Figure 2. Circadian Rhythm Of Alertness Cycle, Core Body Temperature, Hormone Secretion, And Melatonin Cycle (McCallum, Sanquist, & Krueger, 2003).

2. External Time Cues

External time cues such as sunrise, sunset, clock time, and traffic noise, help maintain our biological cycles entrained to the 24-hour cycle of the sun (Hockey, 1983). These external time cues are sometimes called zeitgebers, the German word for "time givers" (Kryger, Roth & Dement, 2000). There are two major types of zeitgebers: exposure to bright light and social factors (LeClair, 2001). Scientists have discovered that the majority of individuals, deprived of external cues, operate on a 25-hour cycle instead of a 24-hour cycle (Neri, Dinges, and Rosekind, 1997). Individuals that live in caves or other dimly lit environments typically adopt to a 25-hour cycle (Reite, Ruddy, & Nagel, 2002). Thus, this research finding explains why individuals have an easier time staying awake later than normal, but struggle when attempting to initiate sleep earlier than normal. The synchronization of our 24-hour clock is ordinarily based on the alteration in light and darkness (Neri, Dinges, and Rosekind, 1997).

3. Peaks and Troughs

During the circadian cycle, there are periods of peaks and troughs (Figure 2). Specifically, there are two major troughs that occur during a 24-hour day. Between the time frame of 0300 and 0500, and 1500 and 1700, these natural occurring troughs result in maximum levels of sleepiness. Particularly, the occurrence of afternoon sleepiness will happen whether or not a person eats (LeClair, 2001).

4. Body Temperature

Besides an individual's sleep/wake cycle, the body temperature is one of the more easily measurable physiological circadian markers. The popular belief that the body temperature remains constant at 37°C (or 98.6°F) throughout the day is not accurate. Individual body temperature varies rhythmically over the day. During the periods of peaks and troughs the body temperature differs by about 0.5°C (1°F). Many physiological and psychological measures have been studied however body temperature and sleep/wake cycles have received much attention in the literature. Usually, body temperature and sleep/wake cycles have a phase relationship that 'free-run' to the same

period. Free-running refers to a rhythm that settles down to a 24-hour cycle instead of continuing on with a 25- hour cycle (Hockey, 1983).

5. Disruptions

Alterations in the timing of the sleep/wake cycle such as re-locating to a new time zone or shift schedule changes disrupt the circadian rhythm. Physiological adaptation to these changes could possibly take weeks (Neri, Dinges, and Rosekind, 1997). However, bright light can aid in resetting our circadian clock and help our body adjust more smoothly to a new sleep-wake cycle (Rosekind et al., 1996). Once again, the quality and quantity of sleep is affected when an individual attempts to work or stay awake during their normal sleep time. The conflict between one's circadian rhythm and work schedule exposes individuals to higher risks of developing sleep disturbances and disorders (McCallum, Sanquist, and Krueger, 2003).

D. SHIFTWORK

In our "24-hour society," many activities are carried out at any time; day or night (Rosa & Colligan, 1997). So, critical services which include public safety (e.g., police and fire protection), military defense, health care, transportation, and public utilities (e.g., electrical power, water, and telephone) are also required 24 hours a day. In addition, grocery stores, gas stations, and restaurants have expanded their hours as well to accommodate shiftworkers. As the number of shiftworkers increase, the need for shiftworkers increase also (Rosa & Colligan, 1997). For example, more workers are required to accommodate the needs of shiftworkers, such as transportation and meal services. Further, overtime rates rose from 11.9% in 2002 to 12.6% in 2003 (Kerin, 2004).

According to the results of the *Shiftwork Practices* survey, it is estimated that approximately 24 million Americans are extended hours workers (Kerin, 2004). It is speculated that some industries such as processing, health care, and transportation are attempting to meet economic demands without hiring new employees. These industries reported the highest fatigue problems amongst all the companies represented in the

survey. Unfortunately, the occupations that fall within these industries can jeopardize public safety and health (Kerin, 2004).

Shiftwork has been around since Roman times (normal city traffic was restricted to night hours), and it probably is not going away (Hockey, 1983). Human nature is diurnal, however, shiftwork requires a nocturnal orientation. Having a nocturnal orientation is unnatural for humans. Therefore shiftwork should be examined closely in order to see where potential intervention strategies may be useful in preventing disastrous effects on the well-being, safety, and efficiency of the shiftworkers (Hockey, 1983). It is estimated that approximately 75% of night shiftworkers experience sleepiness during working hours, and 20% of these workers actually fall asleep on the job (LeClair, 2001). Sleepiness can affect a worker's ability to perform safely and efficiently (Rosa & Colligan, 1997). An individual's circadian system, social and family life, and sleep must all be in order to successfully cope with shiftwork. Any imbalance with one factor could cause a negative effect on the others (Hockey, 1983).

1. Resetting the Circadian Rhythm

There are two major problems with shiftwork, particularly at night. One relates to individuals working during the hours that their circadian rhythms tell them to sleep, and the other relates to individuals trying to initiate sleep during the hours that they should otherwise be awake. It is possible to reset our circadian rhythms. However, rapidly rotating shift schedules (sleep-wake cycle) will disrupt the "biological clock." Previous shiftwork and jet lag, and phase shift changes studies have shown that circadian system requires at least a week to adjust to a new routine (Monk, 1986).

The principle time cue for resetting the circadian rhythm is the light-dark cycle. With suitable intensity (usually 3,000 to 10,000 lux) and duration, light can advance or delay circadian rhythms. Exposure to bright light suppresses the production of melatonin, thus causing immediate alertness and temperature-raising effects (Kryger, Roth & Dement, 2000). For example, exposure to bright light shortly before the sleep period begins tends to cause a delay in the circadian rhythm, whereas exposure to bright light shortly before or after awakening tends to cause an advance in the circadian rhythm (Reite, Ruddy, & Nagel, 2002).

As noted earlier, the two circadian rhythms, body temperature and sleep/wake cycles, are focused upon more because the phase relationship between these two patterns 'free-run' to the same period. In some cases, the normal phase relationship between the two may breakdown. This is known as internal dissociation. An example of this condition is when the peak of the body temperature rhythm moves from the end of the waking day to the beginning (Hockey, 1983).

In other cases, two rhythms may 'free run' to different periods. For example, the body temperature rhythm may follow the normal 24-hour period while the sleep/wake cycle follows a 33-hour period. Resetting an individual 'biological clock' can be accomplished by time cues. In our society, times cues, physical or social, are everywhere, even on the job. However, these time cues can adversely work against allowing the circadian system to adjust to a new routine (Hockey, 1983).

2. Types of Shift Schedules

Since our circadian system is diurnal by nature, it is important for schedulers to understand the work patterns of morning, evening, and night shifts (Monk, 1986). It is understood that the rate in which shifts change and the direction of the rotation may impact an individual's adjustment to the change. The degree of circadian rhythm phase adjustment is determined by the rate with which shifts change, and the direction of rotation determines whether or not the circadian rhythm phase requires advancement or needs shortening. These aspects categorize the main three types of shift systems, permanent, slowly rotating, and rapidly rotating shift schedules (Monk, 1986).

During this period of realignment, the circadian rhythm is in a state of disharmony. An individual is performing activities at times that are counter to their normal circadian system, thus creating an inappropriate phasing problem. With a rapid change in shift rotation, phasing between important biological rhythmic cycles (e.g., sleep-wake cycles, hormone secretion, body temperature regulation, digestion, respiration, performance capabilities, and mood) is "off track." This condition can induce impaired performance, illnesses, mood changes, and poor sleep. To avoid inappropriate phasing problems, night shiftworkers in a rapid rotation are scheduled to work two to three days followed by a day-off for recuperation (Monk, 1986).

As a result, shiftworkers, especially night shiftworkers, encounter increased sleepiness on the job and reduction in daily sleep requirements (Porcu, Bellatreccia, Ferrara & Casagrande, 1998). For many night shiftworkers, sleepiness on the job is caused by sleep loss. On average, night shiftworkers have a 2-4 hour reduction in sleep length (mostly stage 2 and REM sleep). As sleepiness increases, the ability to be visually vigilant and to respond quickly becomes susceptible to degradation. In many work environments (processing, health care, transportation, civil/military ops), there is little room for human error (Porcu, Bellatreccia, Ferrara & Casagrande, 1998).

a. Rapidly Rotating Shift Schedules

In a rapidly rotating shift schedule, individuals work about one or two shifts in a row before switching to another shift. For example, an individual may cycle through shifts by working two morning shifts, followed by two evening shifts, followed by two night shifts, then have two to three days off (Hockey, 1983). Rotating shiftworkers have more complaints than shiftworkers on other schedule types concerning their physical health and psychological stress, because is not easy trying to get used to changing work times. The majority of the 24-hour U.S. Air Force air traffic control operations use this schedule because it minimizes chronic desynchronosis (Luna, French, Mitcha & Neville, 1995).

Research conducted by Monk (1986) compared the temperature and subjective alertness of six male process controllers on a rapid rotating schedule to the night readings (while in bed) of fifty-nine normal male daytime workers collected by Colquhoun (1971). The results showed that rapidly rotating shift schedules with periods of recuperation (i.e., days off) allowed shiftworkers to maintain their normal circadian rhythms without disruption. The temperature readings from both data collections followed the same periods of peaks and troughs. When the temperature readings were at the lowest point, the level of alertness was also low (Monk, 1986). The Colquhoun temperature data, however, were slighter lower due to inactivity. It is important to note that even though the rapid rotating schedule with periods of recuperation prevented inappropriate phasing problems, the levels of alertness of participants were still low during their work schedule (Monk, 1986).

b. Slowly Rotating Shift Schedules

Conversely, night shiftworkers may work on a slowly rotating schedule. In a slowly rotating schedule, night shiftworkers are scheduled for longer periods of time on the same night shift, such as 21 days or longer. The concept behind this idea is that the night shiftworkers will adapt to these changes without experiencing any inappropriate phasing problems. However, it is quite easy for night shiftworkers to revert back to their normal circadian rhythms on their time off (Monk, 1986). Numerous time cues such as sunrise, sunset, clock time and traffic noise that surround our daily activities encourage our biological clock to reset (Hockey, 1983).

For example, twenty-two nurses on a fixed shift schedule for an average of 40.6 months were participants in a shift rotation study (Monk, 1986). The participants always worked nights from 8:45 pm to 7:45 am for 16 shifts per month. On every even-numbered hour, oral temperatures and subjective ratings of alertness were collected. The 24-hour time period analyzed included the nurses' first night shift back after a day-off. The results were also compared to the Colquhoun (1971) study. Only after a two to three daybreak, the nurses' biological rhythms of temperature and alertness had reverted back to their diurnal orientation. When returning to work, the nurses had to regain their nocturnal orientation (Monk, 1986).

c. Permanent Shift Schedules

In a permanent shift schedule, an individual always works the same shift without rotating. Common examples of permanent night shiftworkers are office cleaners and night nurses (Hockey, 1983). A study by Tepas and Mahan (1989) shows that even permanent night shiftworkers have a noticeable amount of sleep loss.

Experienced permanent night shiftworkers normally figure out tricks or personal methods to fight off sleepiness and fatigue (Rosa & Colligan, 1997). It is commonly believed that a permanent night shiftworker can completely adapt to his/her routine after a lengthy amount of time performing their job. However, the majority of permanent night shiftworkers never really get used to their nocturnal routine because of their tendency to revert back to their diurnal orientation on their days off. Understandably, many of them participate in family and social activities and/or run errands and chores that can only be done during the day (Rosa & Colligan, 1997).

E. FATIGUE

Fatigue is defined as ‘weariness or exhaustion from labor, exertion, or stress; the temporary loss of power to respond induced in a sensory receptor or motor end organ by continued stimulation’ (Merriam-Webster Online Dictionary, 2004). Sleepiness, physical tiredness, and inability to focus mentally are experiences that individuals often refer to when describing the term fatigue. Training or years of experience cannot overcome the effects of fatigue. Our bodies have a physiological need for sleep that cannot be denied. We need adequate amounts of sleep for optimal performance and alertness (LeClair, 2001). The combination of fatigue and the circadian low-point could double the effect on an individual’s inability to perform efficiently (Rosa & Colligan, 1997).

Some physiological aspects of fatigue include poor decision-making and communication skills, reduced vigilance, slowed reaction time, nodding off, and being in a bad mood (Rosekind et al., 1996). These deteriorations in an individual’s performance are more noticeable if they remain awake for a prolonged period of time. For example, a study conducted by Caldwell (1997) showed that 17 hours and 24 hours of continuous wakefulness have similar performance degradations as having a blood alcohol concentration (BAC) of 5% and 10%, respectively. In the United States, an individual is legally drunk with a BAC of 8% (LeClair, 2001).

F. MOOD

Adequate sleep prepares the brain for the next day and renews our mental balance (Dement & Vaughan, 2000). Sleep researchers have also concluded that good sleep sets up the brain for positive feelings. Sleep deprived individuals are more easily frustrated, short tempered, and less vital and they have increased complaints about headaches, stomachaches, sore joints or muscles. Severely sleep deprived individuals are grumpier than usual. However, it is more common for people to short themselves on sleep for many sequential nights versus staying up for more than 24 hours. Even though people realize that inadequate amounts of sleep may have adverse affects, they still prefer to sacrifice sleep in order to read a book or watch television (Dement & Vaughan, 2000).

A study conducted by Dinges et al. (1997) administered performance tests and assessed the mood, feelings, and emotions of partial sleep deprived volunteers during the

day (Dement & Vaughan, 2000). The volunteers were restricted to an average of 4.98 hours of sleep per night for seven consecutive nights. In addition, they were asked to list any complaints they might have. This question was added to determine if there was a significant increase in complaints about other bodily problems (e.g., stomach problems, headaches). The results of the study conclusively showed that inadequate sleep causes people to feel significantly less happy, more stressed, more physically frail, and more mentally and physically exhausted. Over the testing period, the overall scores for mood and Vigor-Activity steadily declined as their sleep debt accumulated. The mood scores of the volunteers increased when they were allowed to return back to their normal sleeping patterns. The results of this research suggest that people feel better and are livelier when their sleep debt is lowered. Accumulated sleep debt makes people feel lousy (Dement & Vaughan, 2000).

Increased sleep debt can also cause people to become depressed, irritable, and snappish (Coren, 1996). A study conducted by Ford and Wentz (1986) tracked the mood states of 27 interns through their first year of medical service. During the year, 56% of the interns were depressed at least once. Some of their episodes of depression were severe enough to be considered clinically significant. The interns also experienced increased feelings of anger, fatigue, depression, and disordered thinking. These factors showed a correlation with the amount of sleep the interns had in the previous days (Coren, 1996).

Another factor affecting mood is the alerting effort of the "biological clock" (Dement & Vaughan, 2000). The daily combination of the pull of sleep debt and the push of clock-dependent alerting not only dictates our sleep-wake cycles, but also our emotional well-being. For example, Boivin et al. (1997) demonstrated the effects of mood states during different periods of the day. First, he tested his subject's mood at the same time each day. Their mood states strongly correlated with the amount of sleep they received. Next, Boivin et al. (1997) tested the subject's mood at various times of the day when their sleep was held constant. As a result, their mood varied synchronously throughout the day with the peaks and troughs of their circadian cycles (Dement & Vaughan, 2000).

Numerous variables can affect an individual's mood, especially a rapid change in

their sleep-wake cycle. Previous research conducted by Bohle and Tilley (1993) examined the mood changes of thirty-five female nurses during their first experience of night shiftwork. The study examined short-term changes on six dimensions of mood states (Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, and Confusion-Bewilderment) across several consecutive night shifts, and whether or not individual differences contributed to the impact of night shiftwork (Bohle & Tilley, 1993). The first-time night shiftworkers were selected in order to eliminate potential problems or additional variables that may have been added by experienced night shiftworkers. Previous studies ran into problems with self-selection of experienced shiftworkers. By controlling shiftwork experience, other predictor variables (personality, behavioral, and social/organizational predictors) were easily identified and measured before the nightshift rotation began (Bohle & Tilley, 1993).

To assess mood, the subjects completed POMS at 0700 on the day prior to the start of the night shift, and at 0700 after finishing a night shift. They were also asked to complete a sleep and a temperature log on the day prior to the start of the night shift, and everyday afterwards up to the final night shift and including the following day. The results of this study conclude that Fatigue-Inertia and Vigor-Activity were the categories most affected amongst the dimensions of mood states investigated. The mood states Fatigue-Inertia and Vigor-Activity deteriorated greatly between the first day and the day prior to the start of the nightshift rotation (Bohle & Tilley, 1993). Other studies conducted by Wynne et al. (1984) and Tasto et al. (1978) showed that nightshift work not only affects Fatigue-Inertia and Vigor-Activity, but also Confusion-Bewilderment.

1. USAF Military Airlift Command

At the 437th Military Airlift Wing, Charleston Air Force Base, five C-141B crews were selected to participate in a study of subjective mood conditions during **Operation Desert Storm**. In order to support the coalition forces and meet the increasing demand for food and supplies, the number of supply missions was also increased. The crews shifted from 125 cumulative flight hours per 30-days to 150 cumulative flight hours. In addition to the schedule change, the aircrew members were making eastward flights, which cause more disruptions in sleep than westward flights. One investigator accompanied the crews from the sustained Operations Branch of Armstrong Laboratory.

The data collection included POMS, activity log, oral temperature and fatigue ratings, location, and quality of sleep (French et al., 1992).

The POMS was administered to the crewmembers during the final week of Operation Desert Storm and 1-week after the shift back to their normal schedules. Within these timeframes, the crewmembers took the subjective tests twice in a Military Airlift Command (MAC) crew duty day; once in the beginning and again at the end. The MAC crew duty day is comprised of two intervals; legal for alert (LFA) and crew rest (CR) intervals. The CR intervals start as soon as the aircraft lands and lasts for a minimum of 12 hours. However, during the timeframe the crewmembers must manage time to secure the aircraft, wait on transportation to the operations building and to billeting, receive updates, return weapons, eat, perform personnel hygiene etc. Due to this multi-tasking, the adequate amount of time needed for sleep is often not available (French et al., 1992).

The cumulative flight hours were then broken down into four distinct blocks from 0-75, 76-100, 101-125, and 126-150. There were no significant mood changes noticed during any of the cumulative flight blocks. The combination of cumulative flight hours beyond 125 hours per 30-day and recent (within 24-28 hours) inadequate sleep, however, affected the Vigor-Activity mood state. The study also concluded that the crewmembers' Fatigue-Inertia scores were extremely high early in the morning (0400 Eastern Time) for both LFA and CR intervals. In turn, the study proves that sleep-wake cycles are difficult to adjust in a short period of time (French et al., 1992).

2. USAF Air Traffic Controllers

The use of forward rapid shift rotation schedules in safety critical operations (i.e., air traffic control) may also lead to some concern (Luna, French & Mitcha, 1997). In general, speed, accuracy, vigilance and attention span of workers are consistently lower at night. An observational study over a 3-week period covering 2.5 shift rotation cycles was conducted at Loring AFB, ME to evaluate the shift-specific sleep, general activity levels, mood and cognitive performance of air traffic controllers. As mentioned previously in the literature, the majority of all 24-hour U.S. Air Force air traffic controllers work a forward rapid rotation shift schedule. The participants were comprised of Radar Approach Control (RAPCON) and Control Tower (Tower) personnel, working

either a standard 2-2-2 forward rapid rotation schedule or the 1-1-1 forward rapid rotation schedule (Luna, French & Mitcha, 1997).

Again, POMS was used to measure mood states at the midpoint of each duty shift (Luna, French & Mitcha, 1997). The raw and standardized T scores were computed for the male (n=12) ATCs. The results showed that the ATCs were more fatigued and confused and had lower ratings on vigor on the nightshift when compared to the day or swing-shifts. The RAPCON results revealed greater confusion and less vigor than the Tower ATCs. However, there were no significant differences in anger, tension, or depression. During the first and second days on each shift, there were no differences in any of the mood states (Luna, French & Mitcha, 1997).

3. Sailor's Physical and Psychological State During Prolonged Periods of General Quarter (GQ)

Well-trained and physically fit military personnel can function under high stress workloads (Burr, Palinkas, Banta, Congleton, Kelleher & Armstrong, 1990). However, sustained readiness conditions (e.g., battle readiness or general quarters) of long durations can lead to fatigue and sleep deprivation. These sustained readiness conditions could possibly cause stress on military personnel that could potentially affect their health and performance (Burr, et al., 1990). As a result, degraded physical and psychological states of military personnel could jeopardize the mission of a ship and the safety of its crew. Under GQ conditions, there has been little or no research conducted to identify the relationship between health and psychological mood of military personnel during actual combat conditions. Therefore, a sub-sample of the officers and enlisted crewmen aboard a U.S. Navy frigate (FFG) and guided missile cruiser (CG) in the Arabian Gulf were selected for an intensive examination of sustained operations on health and mood over a 24-hour period prior to, during, and after a period of GQ. POMS were administered to evaluate the baseline, pre-GQ, post-GQ, and recovery periods (Burr, et al., 1990).

The mean scores of all six mood factors were compared to the standardized norms for college students (Burr, et al., 1990). All of the mean scores fell within one standard deviation of the standardized norm based on a sample of college students, resulting in no significant difference. There was a significant decline in negative mood scales of Tension-Anxiety, Anger-Hostility, and Depression-Dejection over the 24-hour period for

both ships. It is suggested that these military personnel may have developed a certain level of adaptation to the stressors associated with sustained operations. In addition, the sub-sample of the crewman aboard the CG showed a significant decline in mood scales, Vigor-Activity as well as an increase in Fatigue-Inertia and Confusion-Bewilderment prior to and after GQ. The crewmen aboard the FFG also reported a high level of fatigue. Increased fatigue and confusion suggests that there was a certain amount of degradation in health and psychological well-being of the crewmembers during GQ (Burr, et al., 1990).

4. Navy Seal (BUD/S) Trainees

In the armed forces, performance during sustained operations is a critical issue; especially when sleep is a factor (Tharion, et al., 1997). In some cases, caffeine has been shown to improve performance. By public opinion, caffeine is considered to increase alertness. A group of sixty-eight Basic Underwater Demolition/SEAL (BUD/S) trainees from the Naval Special Warfare Center in Coronado, CA volunteered to take caffeine pills during Hell Week, the week of minimal sleep, intense physical, mental and environmental stress. Each BUD/S trainee was assigned to one of the following dose groups: 100 mg, 200mg, 300mg or a placebo group. Caffeine was administered at various doses to determine at what level, if any, does mental performance improve in individuals who are sleep-deprived and are in stressful (environmental and operational) conditions (Tharion et al., 1997).

The BUD/S trainees were administered the POMS prior to Hell Week (baseline) and 1-1.5 and 8-10 hours after caffeine/placebo during Hell Week (Tharion et al., 1997). Overall, the 200 mg dose group showed lowest levels of tension, depression, anger, and confusion, and a highest level of vigor amongst the groups. In addition, the 200 mg dose did not pose any physiological or psychological risks that were associated with the 300 mg dose. Therefore, it was recommended that 200 mg of caffeine be used to improve mental performance of sleep-deprived individuals during combat stress (Tharion et al., 1997).

In the various studies mentioned above, shiftwork can affect an individual's mood state. These individuals were faced with the adjustment of their sleep-wake cycles in a

short period of time or in adverse conditions. For public health and safety, it is vital to be aware of any degraded physical and/or psychological states of people in the workplace.

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III. METHODS

A. OVERVIEW

The main objective of this study is to determine if reversing sleep-wake cycles has an effect on one's behavior, specifically, one's mood. The analysis will assess changes in individual mood states from nightshift to dayshift. Also, the study will examine whether the POMS scores from the two shift conditions, nightshift versus dayshift, are consistent and will further determine the variability of the data collected from one period to the next. The analysis will include a regression model of the POMS results, actigraphy data, and whether or not the crewmembers were exposed to light immediately prior to their major sleep epoch.

B. PARTICIPANTS

Major efforts were taken to attract participants that represented watchstanders from different departments aboard the ship. However, the sample was for volunteers only. No one was forced to participate. For this analysis, a total of twenty-four participants were used. Of the twenty-four participants, nineteen were men and five were women having an average age of 24.88 years. They represented ten different departments of the ship's force and air wing, and had various military experiences and educational backgrounds. All of them signed a participant consent form, minimum risk consent form, and privacy act statement prior to the start of data collection. Originally, thirty-three enlisted crewmembers aboard the USS JOHN C. STENNIS (CVN-74) volunteered to take part in this study (Miller et al., 2003). However, five of the crewmembers were omitted from the analysis because it was discovered that those individuals were working days and sleeping at night, contrary to nightshift work (Nguyen, 2002). Another four of the crewmembers were omitted because of incomplete data sets.

C. COLLECTION

1. Description of Profile of Mood States

In psychology, subjective data of measured feelings and moods states are frequently used along with physiological and other behavioral data (McNair, Lorr, & Droppleman, 1992). The Profile of Mood States (POMS) was developed as a fast and economical method for assessing subjective mood states. Previous studies with varying populations (i.e., experimental clinical research, a routine clinical assessment program in a major university medical center psychiatry clinic, and selected samples of normal college students) have proven that the POMS is effective among psychiatric populations as well as non-psychiatric populations. Numerous studies have assessed the reliability and validity of the POMS (McNair, Lorr, & Droppleman, 1992). For this study, sailors aboard the USS JOHN C. STENNIS (CVN-74) were administered the POMS to collect data on their mood states while deployed.

2. Interpretation of the POMS Factors

The POMS is based on a 65 five-point adjective rating scales (see Appendix A) that measures six identifiable mood or affective states: Tension-Anxiety; Depression-Dejection; Anger-Hostility; Vigor-Activity; Fatigue-Inertia, and Confusion-Bewilderment (McNair, Lorr, & Droppleman, 1992). A 7th grade education is necessary to understand the sixty-five adjective word list. All participants in this study had at least a high school diploma or had successfully completed the General Educational Development (GED) Test, so it can be concluded that the subjects did not have any difficulties comprehending the word list.

a. Tension-Anxiety

Tension-Anxiety, or Factor T, encompasses descriptive adjectives that deal with uncertainty and heightened musculoskeletal tension (McNair, Lorr, & Droppleman, 1992). These descriptors include Tense, Shaky, On Edge, Panicky, Relaxed, Uneasy, Restless, Nervous, and Anxious. If escalated, these descriptors can indicate physiological changes. Some of these physical manifestations (Shaky, Restless) are noticeable, while others (Tense, On Edge) are not quite as noticeable (McNair, Lorr, & Droppleman, 1992). Individuals who are unable or unwilling to face emotional problems may

subconsciously somatize them into physical complaints (Hafen, Karren, Frandsen, & Smith, 1996). Even though most people experience some anxiety everyday, excessive amounts are known to cause health problems (Hafen, Karren, Frandsen, & Smith, 1996).

b. Depression-Dejection

Depression-Dejection, Factor D, entails a broad range of personal mood inadequacies (McNair, Lorr, & Droppleman, 1992). Within this category, adjectives such as Blue, Lonely, Helpless, and Miserable may describe individuals who have isolated themselves from others and/or who has given up on important activities such as work or hobbies. Adjectives, including as Guilt or Sorrow, may describe individuals that regret their actions or lack of accomplishments (McNair, Lorr, & Droppleman, 1992). From time to time, an individual may feel sad or unhappy. To others they may seem depressed, but that does not necessary classify them as being clinically depressed (Hafen, Karren, Frandsen, & Smith, 1996).

c. Anger-Hostility

Anger and hostility can emerge from numerous situations, and every person reacts to and expresses these moods differently (Hafen, Karren, Frandsen, & Smith, 1996). Misdirected or suppressed anger can lead to escalated situations/conflicts, miscommunication, acquiring angry habits, loss of self-esteem, and loss of respect for others (Hafen, Karren, Frandsen, & Smith, 1996). Anger-Hostility, Factor A, represents these moods (McNair, Lorr, & Droppleman, 1992). Overt expression of anger and hostility are typically described as Ready to Fight, Angry, Bad-Tempered, and/or Rebellious. Milder cases of anger and hostility are typically described as Grouchy and Annoyed (McNair, Lorr, & Droppleman, 1992).

d. Vigor-Activity

Unlike the other factor scales that are defined by adjectives suggesting negative mood states, Vigor-Activity, Factor V, is defined by adjectives suggesting positive moods states (Vigor-Activity, Ebullience, and High Energy) (McNair, Lorr, & Droppleman, 1992). These adjectives capture the liveliness and alertness of a subject's mood. In this category, people that are highly concerned or aware of the situations and conditions surrounding them are described as Lively, Full of Pep, or Vigorous, while

other who let worries or concerns “slide off their back” are described as Carefree (McNair, Lorr, & Droppleman, 1992).

e. Fatigue-Inertia

Fatigue-Inertia, Factor F, is the opposite of Factor V. This scale is defined by adjectives describing low energy level, tiredness, and fatigue. The adjective Tired does not appear on the test; however, adjectives such as Worn-out, Exhausted, and Sluggish are used instead (McNair, Lorr, & Droppleman, 1992).

f. Confusion-Bewilderment

Lastly, Confusion-Bewilderment, Factor C, is used as a “wild card” (McNair, Lorr, & Droppleman, 1992). It is difficult, however, to determine whether the factor represents a trait of cognitive inefficiency, a mood state, or both. Descriptors such as Confused, Unable To Concentrate, and Uncertain About Things suggest that this factor may be related to emotional disorganization (McNair, Lorr, & Droppleman, 1992).

3. Test Instructions and Scoring Procedures

The average time to complete a POMS test is 3-5 minutes (McNair, Lorr, & Droppleman, 1992). The time interval that subjects are told to use when responding is often modified. For this study, the test instructions of the standardized test were modified to ask how the participants were feeling during the past 24 hours. It required them to describe their feelings by selecting one of the following intensity modifiers; 0=Not at all, 1=A little, 2=Moderately, 3=Quite a bit, and 4=Extremely associated with a list of words. Each modifier has an assigned weight of 0, 1, 2, or 3. However, the adjectives “Relaxed” from the Tension-Anxiety factor and “Efficient” from the Confusion factor have negative weights assigned to them. The responses from each mood factor are then totaled separately and analyzed. Summing the scores of 5 negative POMS factors, Tension-Anxiety; Depression-Dejection; Anger-Hostility; Fatigue-Inertia, and Confusion-Bewilderment together, then subtracting the Vigor-Activity score results in the Total Mood Disturbance Score (TMD). The TMD score can be used as a single global estimate. It represents a highly reliable intercorrelation among the six mood factors (McNair, Lorr, & Droppleman, 1992).

D. PROCEDURE

The POMS was administered to the crewmembers after 30 days of "night shift work", then again 24 hours and 1-week after the shift back to a day schedule. A total of 3 POMS tests were administered to the twenty-four participants. The test score of each mood state was computed by hand using the handscoring key (see Appendix B, C, D, E, F, & G). Each factor has a different handscoring key which corresponds to the associated adjectives within its' category. For example, the Fatigue-Inertia handscoring key only computes item number 4, 11, 29, 40, 46, 49, and 65, which corresponds to the adjectives Worn-out, Listless, Fatigued, Exhausted, Sluggish, Weary, and Bushed, respectively.

The handscoring key is placed over the completed POMS Answer Sheet. The item response is then multiplied by an indicated weight (+1 or -1), and summed for the total raw score of that mood state. Tension-Anxiety (Factor T) and Confusion-Bewilderment (Factor C), contain a negatively weighted item, so a numeric constant of +4 is added to these totals to eliminate negative scores. Summing the raw scores of 5 negative POMS factors, Tension-Anxiety; Depression-Dejection; Anger-Hostility; Fatigue-Inertia, and Confusion-Bewilderment together, then subtracting the Vigor-Activity raw score results in the raw TMD.

Using the tentative norms (T scores) table in Appendix H, raw scores of each mood factor are then converted to standardized T scores. The T scores are used to compare the results of this analysis to a normative sample of college men and women. Since the variance associated with sex was less then 1% percent, only one T score table was necessary (McNair, Lorr, & Droppleman, 1992). All the POMS results were entered into an Excel worksheet, and these files were imported into SPSS for further analysis.

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IV. RESULTS

As a follow-up investigation, this study analyzed the effects of reversing sleep-wake cycles on mood states (using POMS), sleep, and fatigue of the crewmembers and Air Wing 9 of the USS JOHN C. STENNIS (CVN-74). This analysis also determined the correlation between POMS results and the quantity and quality of sleep received by the crewmembers. Other variables (e.g., working condition (topside or belowdecks), tobacco use, caffeine consumption, and gender) were also considered.

A. ANALYTICAL APPROACH

The analytical approach for this study included a detailed statistical analysis of the POMS results collected after 30 days of "night shiftwork"; then again 24 hours and 1-week after the shift back to a day work/night sleep schedule. The POMS scores were compared to normative data to determine if Sailors' POMS scores were in the range of normal. A repeated measures analysis of variance was conducted to look at changes over the three time points and to determine how those changes may be related to age, gender and workplace (topside or belowdecks). All statistical tests were conducted at the α = 0.05 significance level.

B. SAMPLE AND DEMOGRAPHICS

The sample size for this analysis was twenty-four (n = 24). The participants represented ten different departments of the ship's force and air wing, and had various levels of military experience and educational backgrounds. Factors such as age, gender, tobacco use, caffeine consumption, and workplace (topside versus belowdecks) were examined first.

1. Age and Gender

Of the twenty-four participants, nineteen were males and five were females, representing 79% and 21%, respectively, of the volunteers. As shown in Figure 3, at the time of the study, the ages of the participants ranged from 19 to 39 years old with an average age of 24.88 years, standard deviation of 6.4. Most of the females (4 out of 5) were in the lower age bracket. However, there did not appear to be a significant

difference for age by gender.

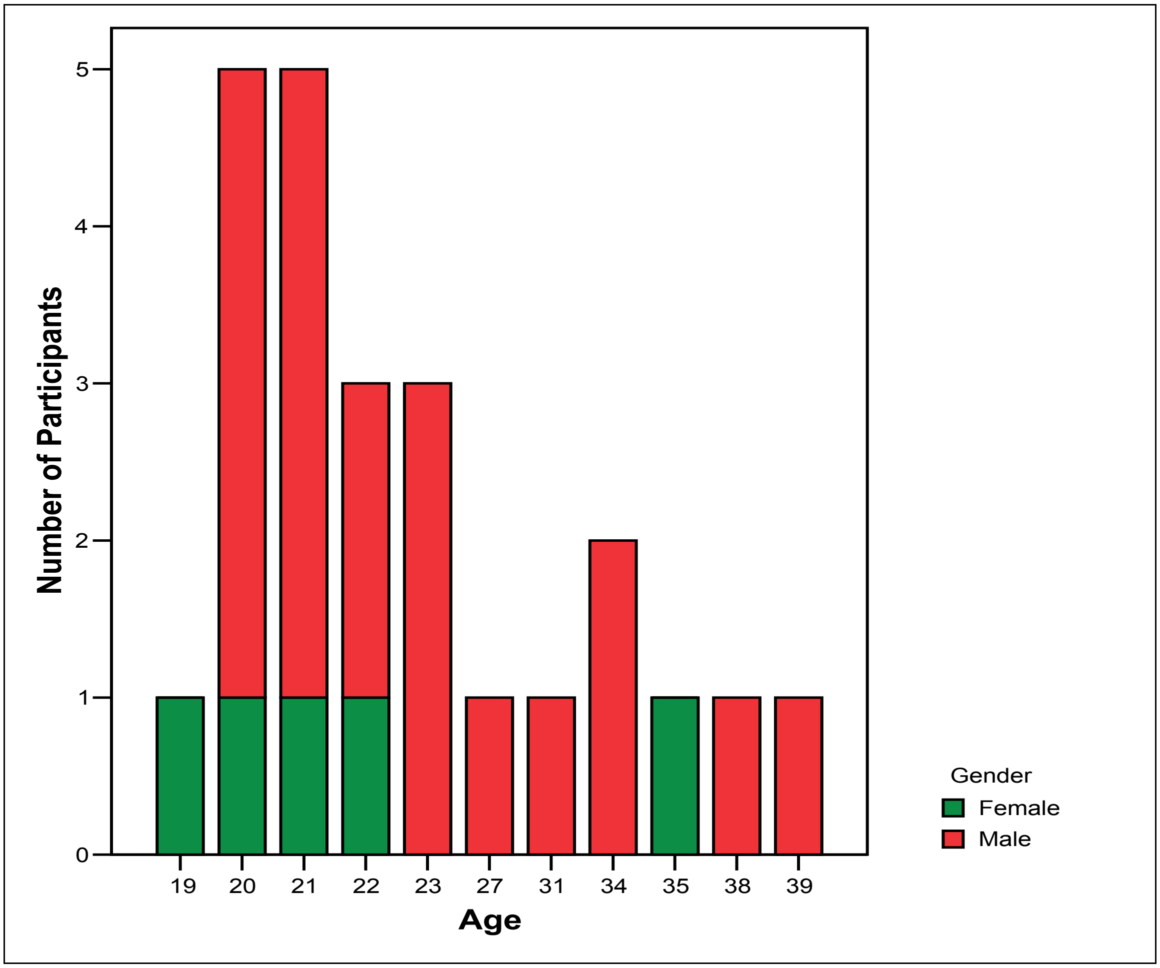

Figure 3. Histogram of Age and Gender

2. Tobacco Use

Thirteen out of twenty-four (54.2%) participants used tobacco (Figure 4). Of those thirteen, the frequency of tobacco use ranged from 3 cigarettes a day to 2 packs a day. In this case, the Fisher's exact test was used to provide evidence of dependence between the variables. The difference in tobacco use between males and females was not statistically significant ($p = 0.630$).

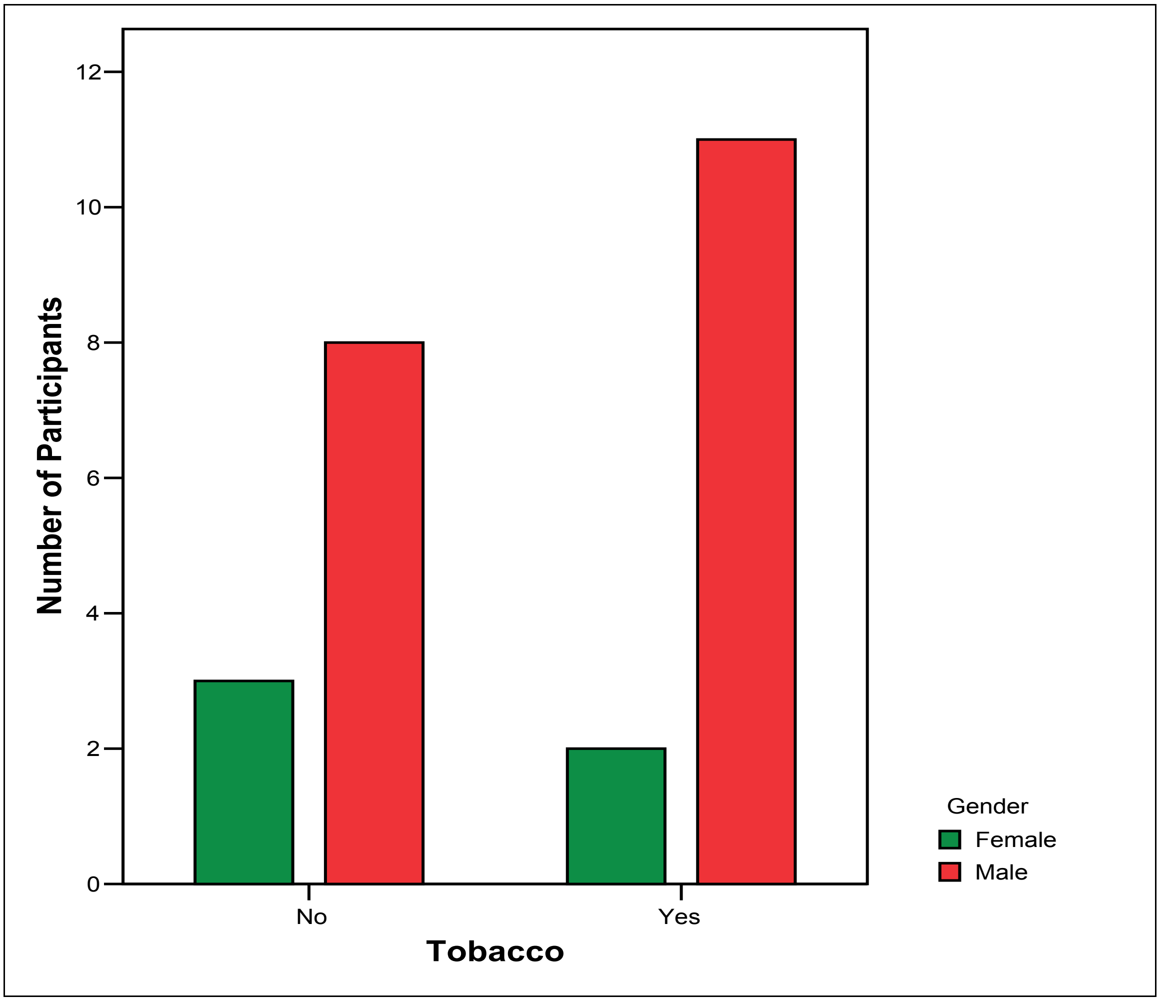

Figure 4. Tobacco Use of Participants by Gender

3. Caffeine Consumption

Most of the participants reported using caffeine products. Only 3 of the participants did not consume any caffeine products as shown in Figure 5. The average 24-hour caffeine consumption among the participants using caffeine was 3.67 servings per day with a standard deviation of 0.64. Again, there did not appear to be a significant difference between the caffeine consumption for males and females.

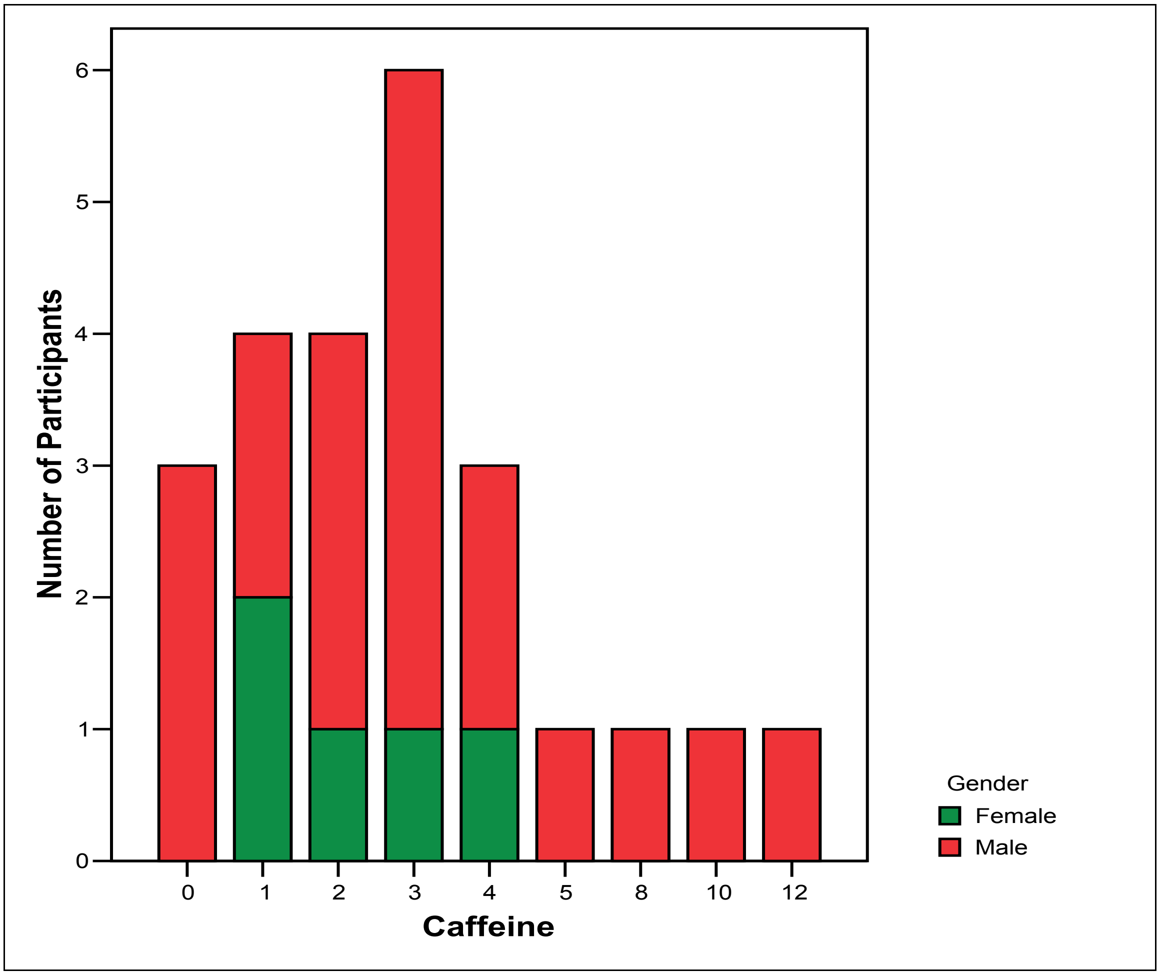

Figure 5. Caffeine Consumption among Participants by Gender

4. Topside/Belowdecks

The number of participants in the two workplaces was nearly equal with 13 out of the 24 participants working topside, and 11 working belowdecks (Figure 6). Individuals working topside were exposed to natural light, which serves as an external time cue or zeitgeber. This light exposure almost certainly reduced naturally occurring melatonin levels in these individuals, thereby affecting their sleep. Individuals working belowdecks had a simulated light environment and were rarely exposed to natural sunlight. (The significance of working topside versus working belowdecks in relationship to sleep quality and quantity is seen later in this section.) Fisher's Exact Test was used to determine if gender is independent of workplace (e.g., more females worked belowdecks than topside). Results ($p = 1.00$) indicated that this was not the case.

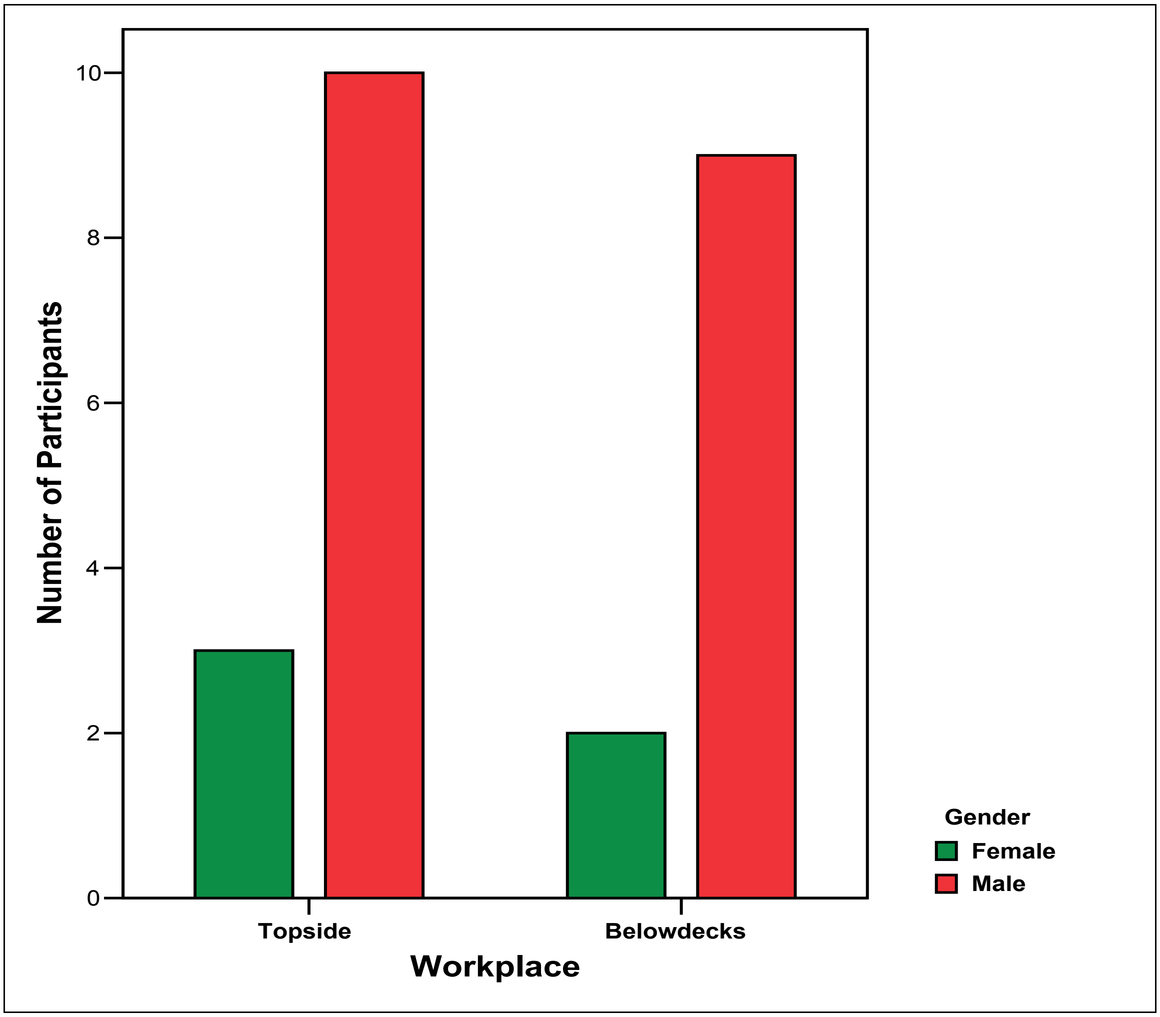

Figure 6. Participants Working Topside and Belowdecks by Gender

C. ANALYSIS OF MOOD SCALES

Data were obtained at three time points: following 30 days of "night shiftwork", then 24 hours and 1-week after the participants shifted back to working a day schedule. The daily shipboard routine of the participants was not altered to accommodate the collection of the POMS data for this study. The main focus of this analysis was to monitor changes in mood that could be associated with their current work schedule, i.e., night shift vs. day shift. Both raw scores and standardized POMS ratings (T scores) were used for this determination.

1. Impact of Time, Gender and Workplace on POMS

Over three repeated administrations, the POMS factor scores were used to monitor changes in mood states. These six factors are Tension-Anxiety, Depression-

Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, and Confusion-Bewilderment. A normative sample of college men and women was used to compute the POMS T scores of the participants. As noted previously, the variance associated with gender for the normative sample was less then 1% percent, so only one T score table that combined males and females was required (Appendix H).

As shown in Figure 7, the mean T scores for Tension-Anxiety at times 1, 2, and 3 were 47.7, 46.92, and 48.25 (*SD*s = 8.95, 10.23, and 10.30, respectively). All the means were below the standardized normal value of 50, *SD* = 10. The sole participant with a significantly elevated Tension-Anxiety score (T = 73) was a male who worked belowdecks. Figure 7 shows this data point at time 3 with the number 17 beside it.

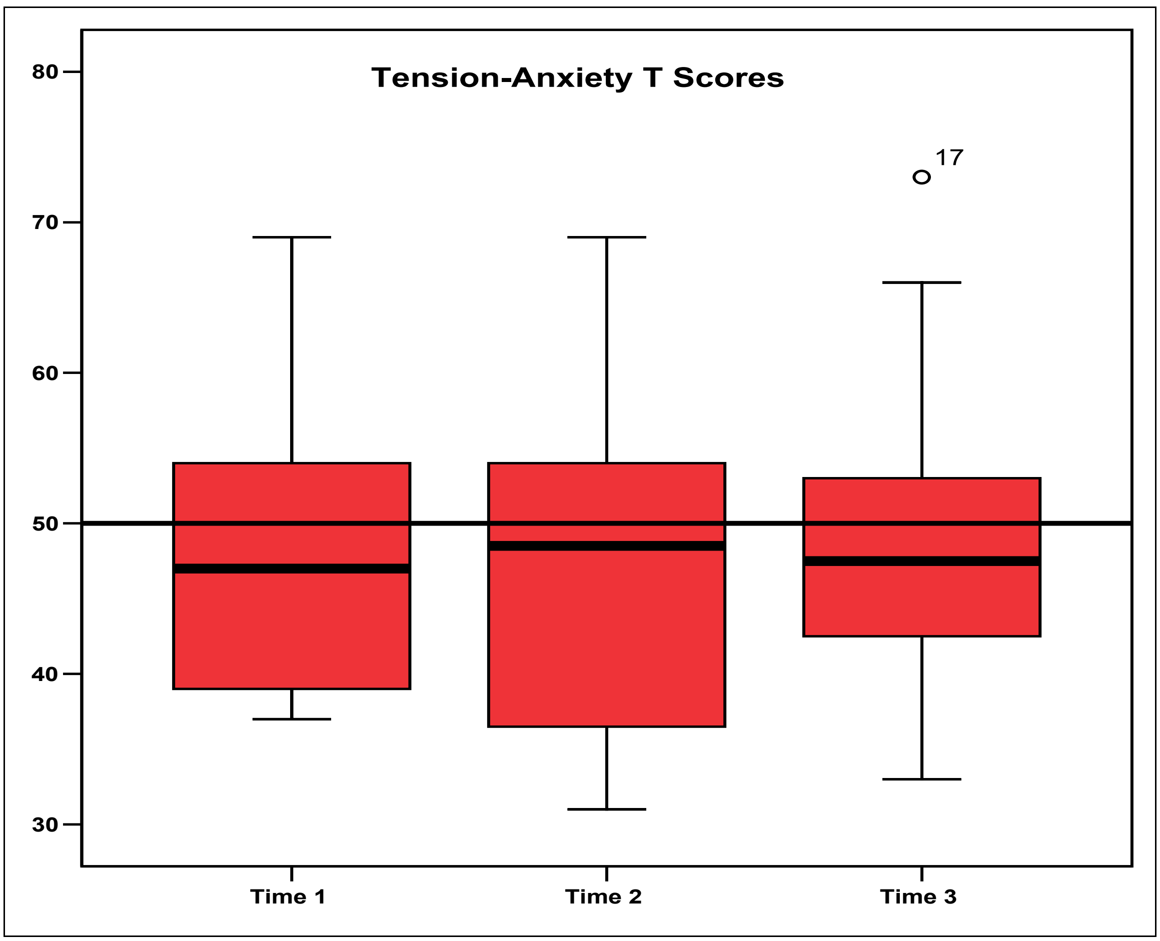

Figure 7. Tension-Anxiety T Scores Over Three Repeated Administrations

In Figure 8, the mean T scores of Depression-Dejection at times 1, 2, and 3 were 49.83, 49.29, and 52.46 (*SD*s = 9.95, 9.92, and 11.72, respectively). At times 1 and 2, the means were below the standard normal, but they were within one standard deviation of the standardized norm, resulting in no significant difference. Again, the male participant that worked belowdecks had higher depression scores of 76, 82, and 77 at times 1, 2, and 3, respectively. The Depression-Dejection T scores at time 3 were elevated slightly. These T scores at time 3 ranged from 42 to 80. The highest T score, 80, was from a female who worked topside. However, there were no significant differences between the mean T scores and the norm.

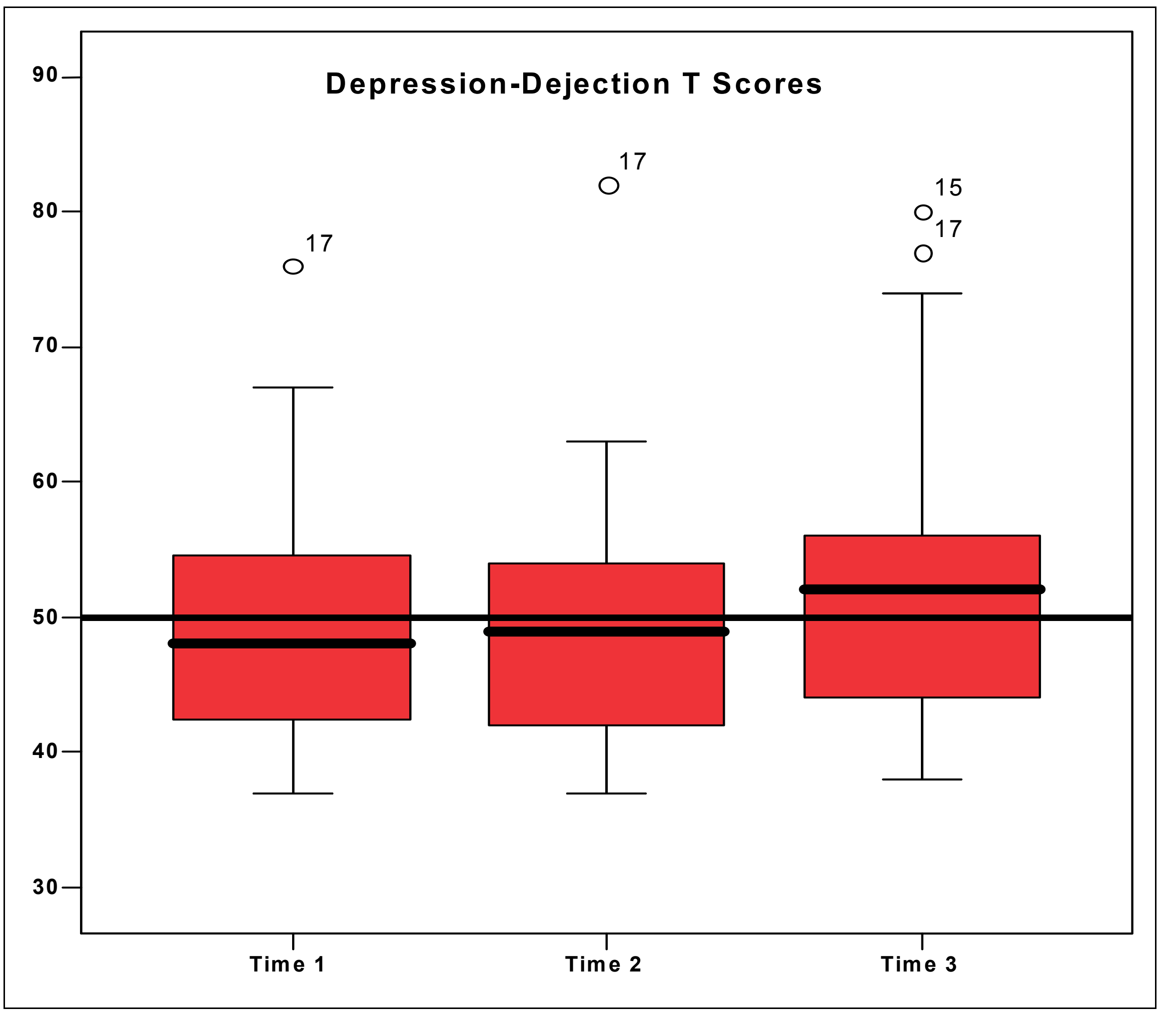

Figure 8. Depression-Dejection T Scores Over Three Repeated Administrations

For all three time points, the Anger-Hostility T scores were elevated. The mean T scores of this factor at times 1, 2, and 3 were 55.71, 55.96, and 58.42 (*SD*s = 13.00, 16.45, and 16.42, respectively) as shown in Figure 9. Most of the participants' T scores were above the norm ranging from 39 to 91 at time 1, 37 to 86 at time 2, and 37 to 95 at time 3. The mean T scores were significantly different from the norm.

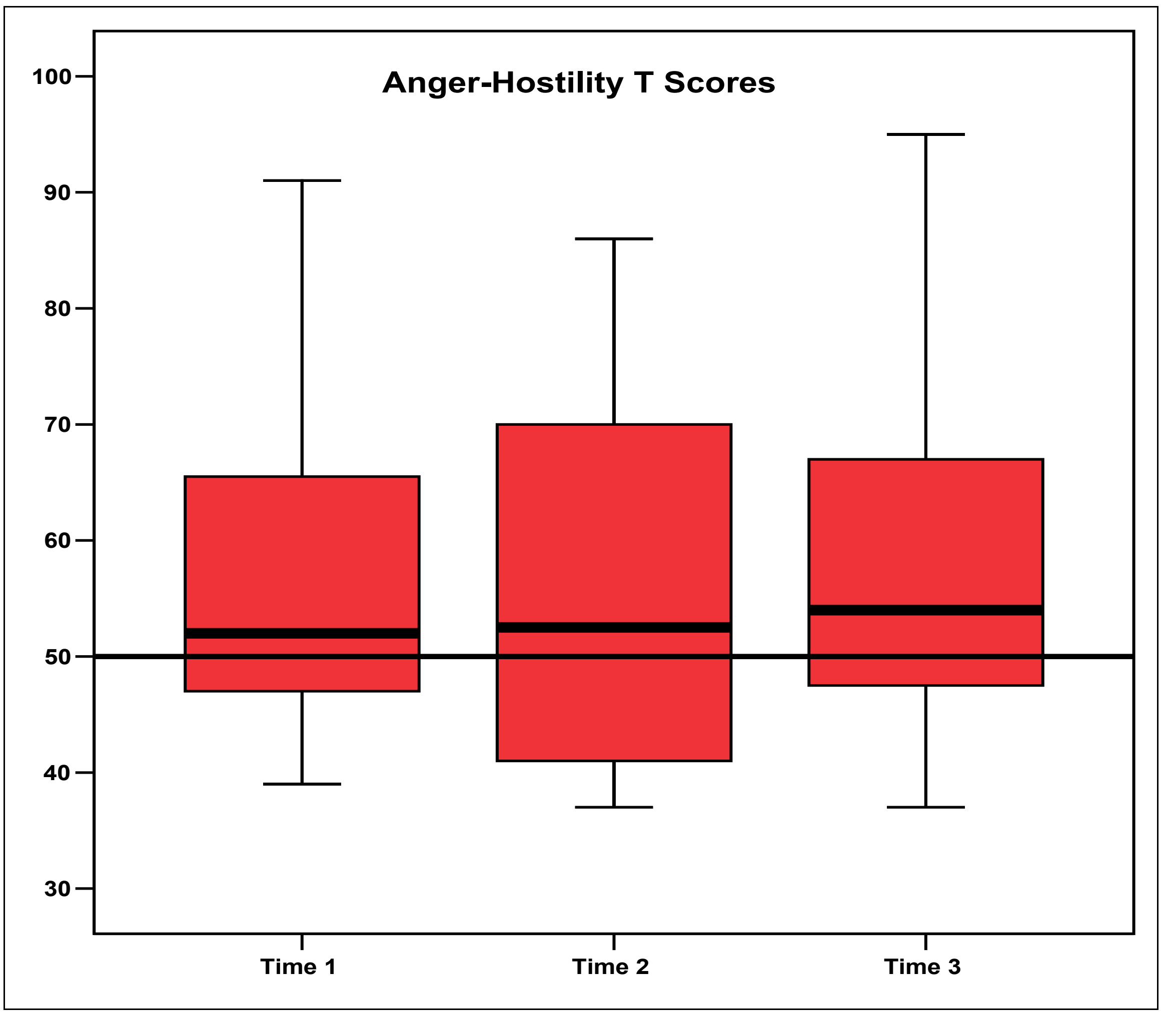

Figure 9. Anger-Hostility T Scores Over Three Repeated Administrations

Since the Anger-Hostility T scores were significantly different from the norm, the T scores were further examined for linear relationships. As shown in Table 1, there was a relationship between age and Anger-Hostility T scores at time 1. Using the Pearson correlation, the variables are significant at the 0.025 level. Having a correlation of -.457, Anger-Hostility T scores were higher in younger participants than the older participants only at time 1. Age, however, was not related to affect Anger-Hostility T scores at the other two time points.

		Age	Anger, Time 1	Anger, Time 2	Anger, Time 3
Age	Correlation	1.000	-.457(*)	-0.285	-0.333
	Sig. (2-tailed)	.	0.025	0.177	0.112
	N	24	24	24	24
Anger, Time 1	Correlation	-.457(*)	1.000	.580(**)	.729(**)
	Sig. (2-tailed)	0.025	.	0.003	0.000
	N	24	24	24	24
Anger, Time 2	Correlation	-0.285	.580(**)	1.000	.657(**)
	Sig. (2-tailed)	0.177	0.003	.	0.000
	N	24	24	24	24
Anger, Time 3	Correlation	-0.333	.729(**)	.657(**)	1.000
	Sig. (2-tailed)	0.112	0.000	0.000	.
	N	24	24	24	24

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 1. Pearson Correlation of Age and Anger-Hostility T scores

The ages of the participants versus the Anger-Hostility T scores for time 1 are shown in Figure 10. Sixteen of the participant's ages ranged from 19 to 23 years of age. Four of them were females. Compared to the 8 individuals in the 25 and older group, the Anger-Hostility T scores of this younger age group were significantly elevated.

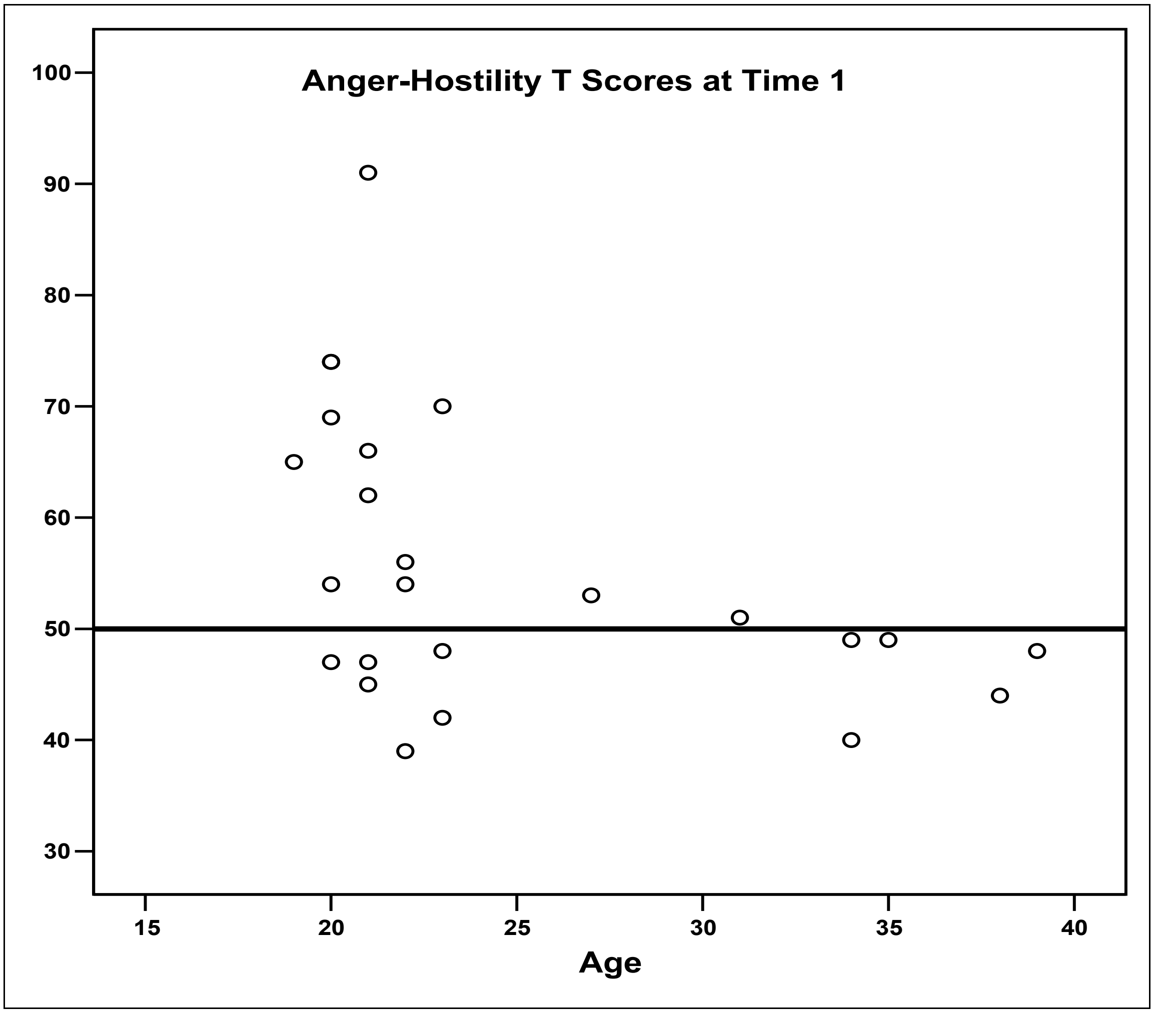

Figure 10. Anger-Hostility T Scores versus Age at Time 1

At times 1 and 3, the Vigor-Activity T scores were elevated, but at time 2 the T scores were lower than the norm. The mean T scores of the Vigor-Activity factor at times 1, 2, and 3 were 51.67, 47.63, and 52.29 (*SD*s = 8.99, 11.46, and 10.50, respectively), shown in Figure 11. Since Vigor-Activity is a positive mood scale, it is preferable that the T scores were higher than the norm. One female who worked belowdecks had an extremely low T score of 27 at time 1. The other participants at this time point had T scores that fell within the norm. At time 2, the mean T scores were significant. These T scores ranged from 29 to 70. However, at time 3, the participants' mean T scores were back within the norm.

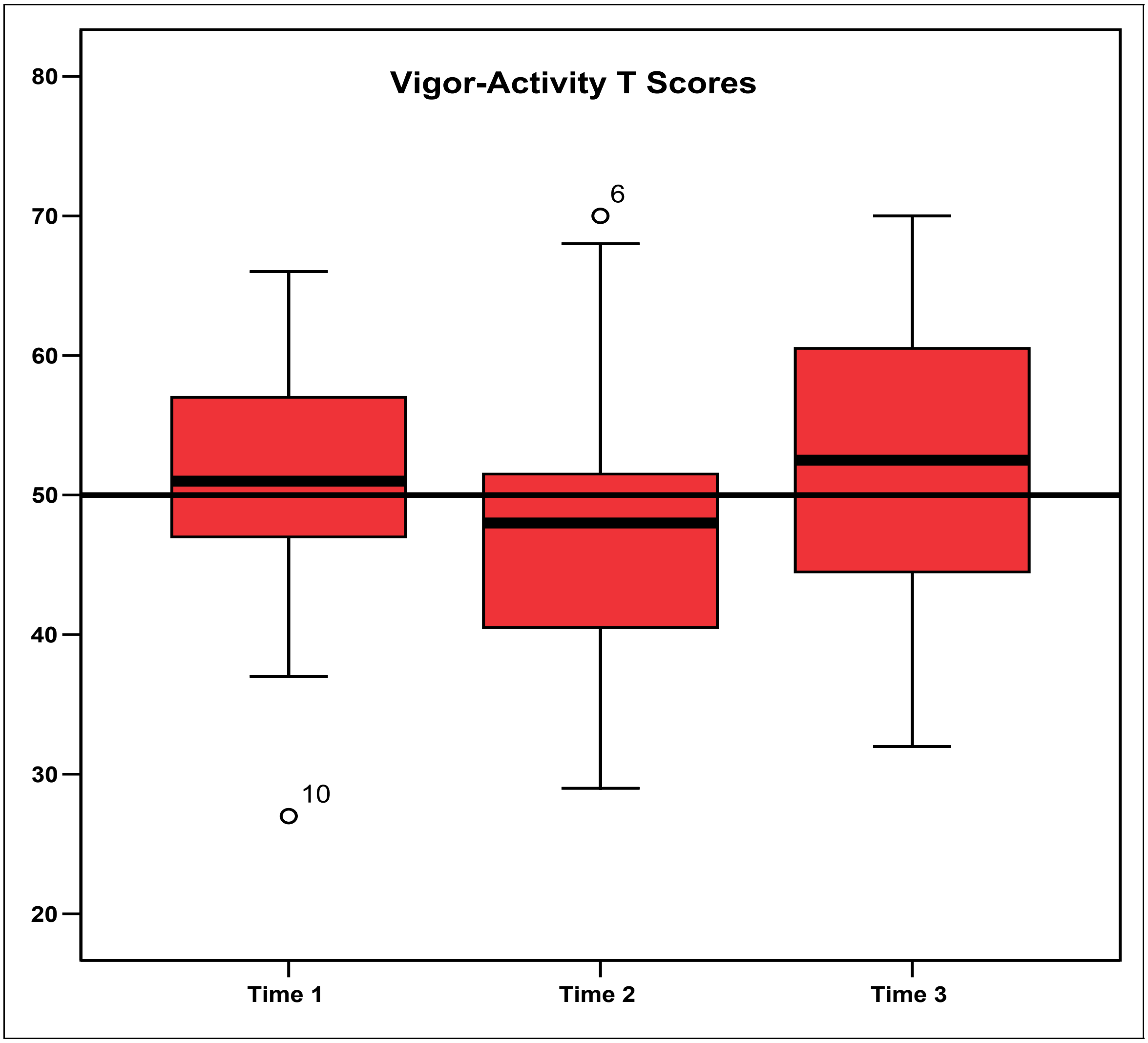

Figure 11. Vigor-Activity T Scores over Three Repeated Administrations

The mean T scores of Fatigue-Inertia at times 1, 2, and 3 were 50.96, 50.96, and 50.00 (*SD*s = 8.01, 10.42, and 10.54, respectively), in Figure 12. At times 1 and 2, the mean T scores of the participants were slightly elevated, but were not statistically significant. Further examination was made to check for linear relationships, but nothing significant was found between time, gender, and workplace. The mean T scores ranged from 37 to 66 at time 1, 34 to 69 at time 2, and 35 to 72 at time 3.

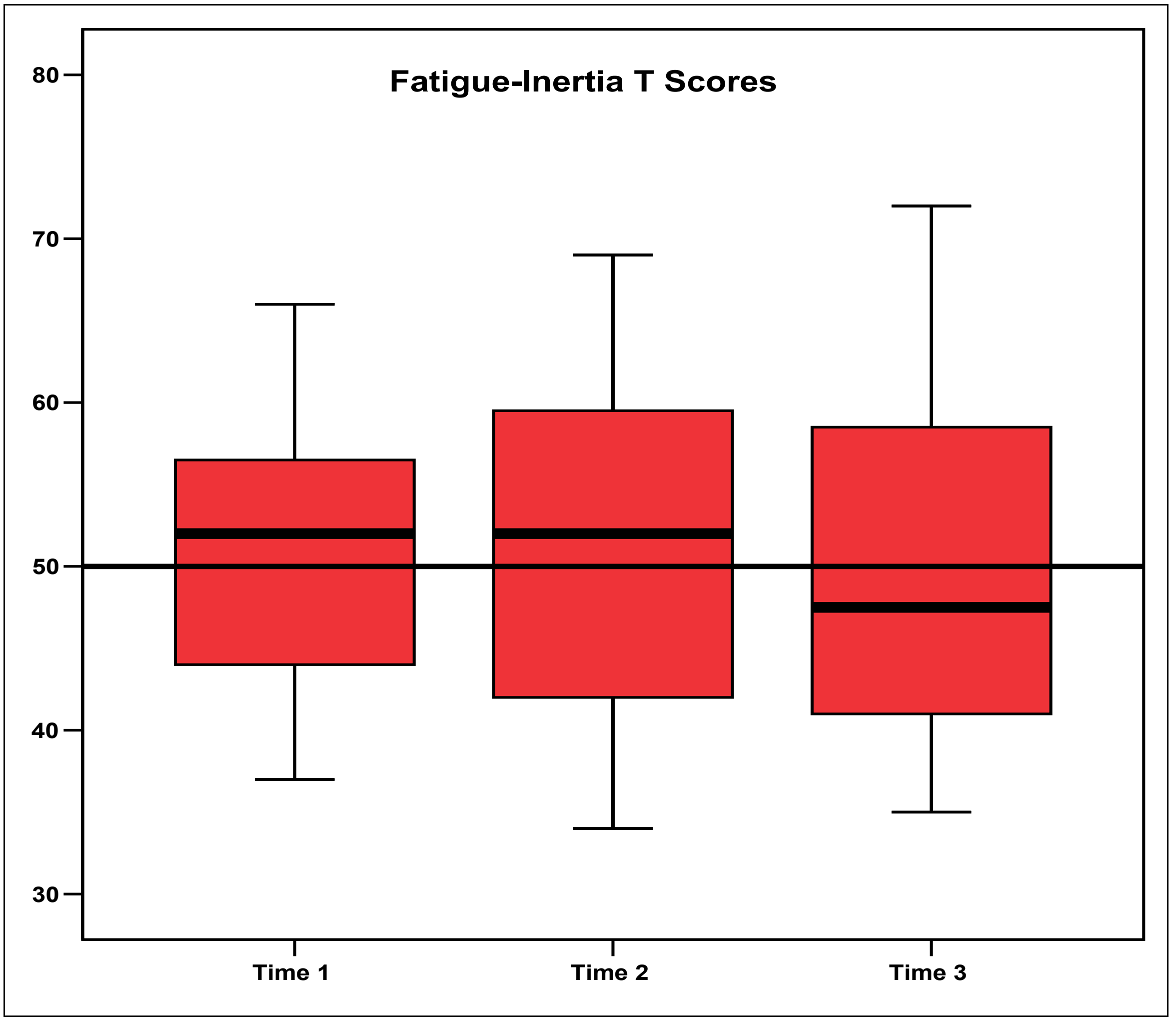

Figure 12. Fatigue-Inertia T Scores Over Three Repeated Administrations

For factor Confusion-Bewilderment, the mean T scores at times 1, 2, and 3 were 46.29, 46.83, and 46.67 (*SD*s = 9.33, 11.05, and 12.07, respectively), shown in Figure 13. The mean T scores ranged from 37 to 70 at time 1, 32 to 68 at time 2, and 32 to 73 at time 3. All of these points were significantly lower than the norm. The sole participant with a significantly elevated Confusion-Bewilderment (T = 70) was a female who worked belowdecks. The number 10 in Figure 13 identifies this data point at time 1.

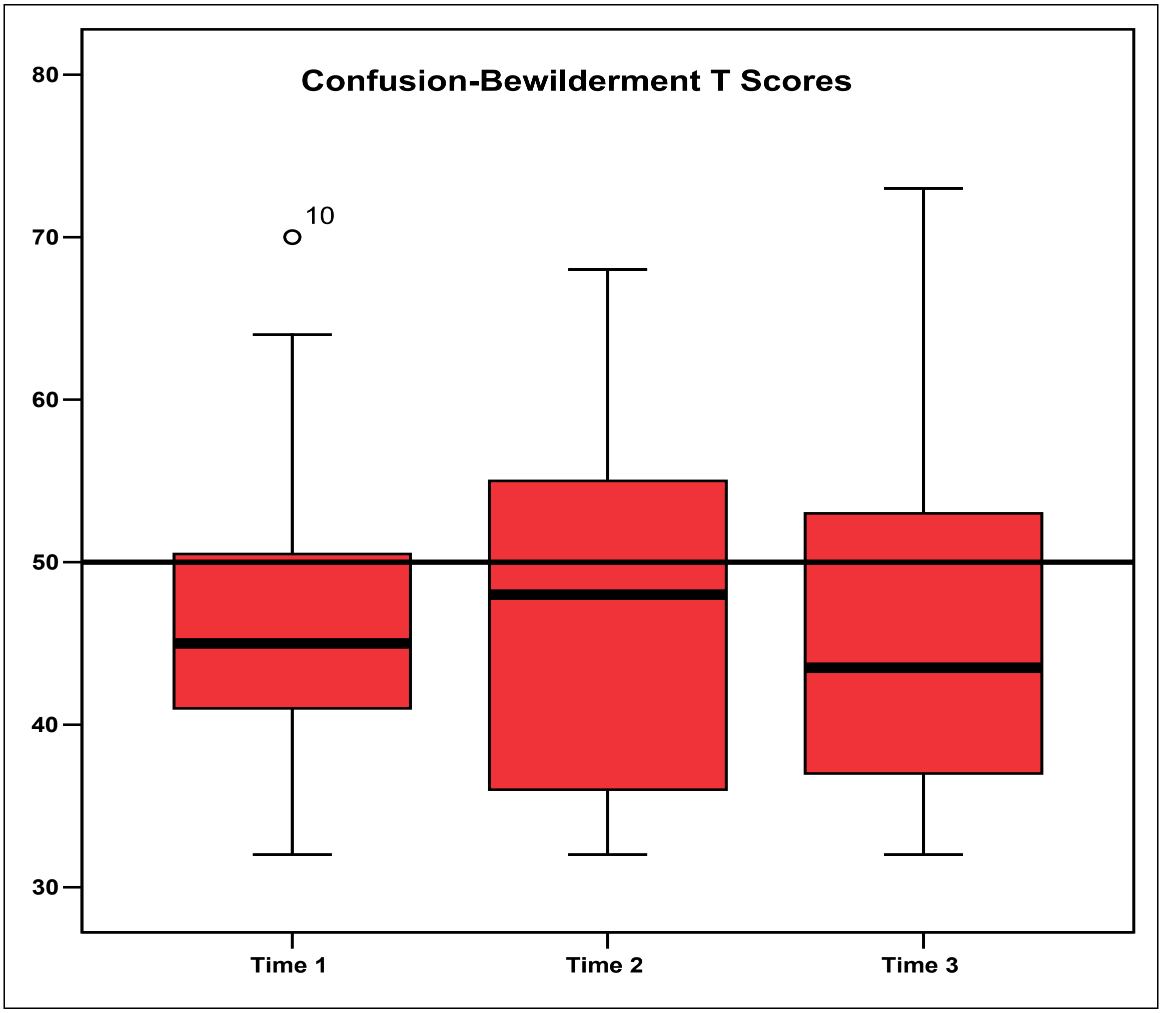

Figure 13. Confusion-Bewilderment T Scores Over Three Repeated Administrations

Again, it is important to note that the population of the participants consisted of 19 males and 5 females. In Figure 7, it was difficult to distinguish which gender caused variability, if any. Even though the data set is relatively small, the raw mean scores of the mood scales and TMD as shown Appendix I seemed to show apparent differences between males and females. Consequently, male and female participants were divided for further analysis.

The Repeated Measures General Linear Model (GLM) was used to analyze groups (i.e., gender and workplace) across the three time points. In this model, the POMS scores at the three time points were used as dependent variables (within subjects) and gender and workplace independent variables (fixed between-subjects factors). Five mood scales factors (Tension-Anxiety, Depression-Dejection, Anger-Hostility, Fatigue-

Inertia, and Confusion-Bewilderment) in the Repeated Measures GLM suggested negative mood states, while Vigor-Activity was defined as a positive mood state. The TMD was used to show a global estimate of the summation of the five negative mood states minus Vigor-Activity.

Using SPSS Multivariate Tests of Significance, the effects of gender and workplace were assessed using repeated measures of mood states over three time points. The Wilks' Lambda test associated with the multivariate approach was used to test for any interactions. As shown in Table 2, there was no main effect on the repeated measures of mood states over the repeated administrations of POMS. None of the mood scale factors or TMD results was significant.

Mood States	Repeated Measures of Mood States		Repeated Measures of Mood States*Gender		Repeated Measures of Mood States*Workplace	
	F	p-value	F	p-value	F	p-value
Factor T	0.337	0.718	3.627	0.046*	0.299	0.745
Factor D	1.668	0.215	6.353	0.008*	0.446	0.646
Factor A	0.782	0.472	3.617	0.047*	0.711	0.504
Factor V	2.793	0.086	4.048	0.034*	3.541	0.049*
Factor F	0.199	0.821	4.865	0.020*	2.23	0.135
Factor C	0.065	0.937	0.784	0.471	1.185	0.327
TMD	0.438	0.652	7.783	0.003*	1.077	0.361

*Significant at $\alpha = 0.05$

Table 2. Wilks' Test Associated With Multivariate Approach

When considering differences in gender, there was a significant interaction between repeated measures of mood states on all factors except Confusion-Bewilderment. For example, there was a significant interaction between time and gender for the mood scale factor of Tension-Anxiety, $F(2,19) = 3.627$, $p < 0.05$. Figures 14 and 15 showed that female participants' mood states are significantly higher than male participants in both working conditions. For female participants working topside (Figure 14), the Tension-Anxiety raw mean scores at times 1, 2, and 3 were 12.33, 14.00, and 17.67 (*SD*s = 8.08, 9.54, and 8.74, respectively). The male participants working topside (Figure 14) had Tension-Anxiety raw mean scores at times 1, 2, and 3 of 12.30, 10.50, and 11.90 (*SD*s = 3.89, 6.43, and 4.67, respectively). Gender differences were also significant for participants working belowdecks (Figure 15 and Appendix J and K).

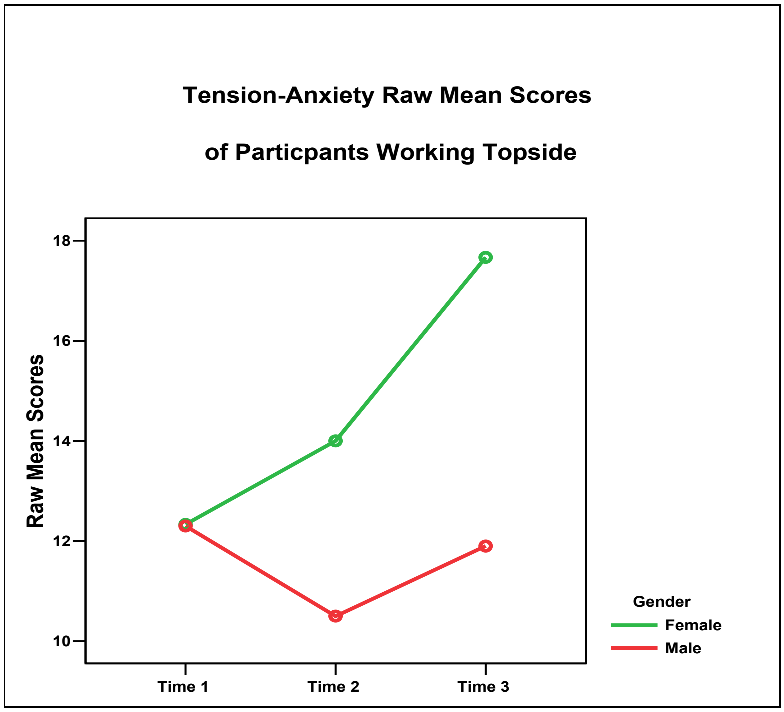

Figure 14. Tension-Anxiety Raw Mean Scores of Participants Working Topside

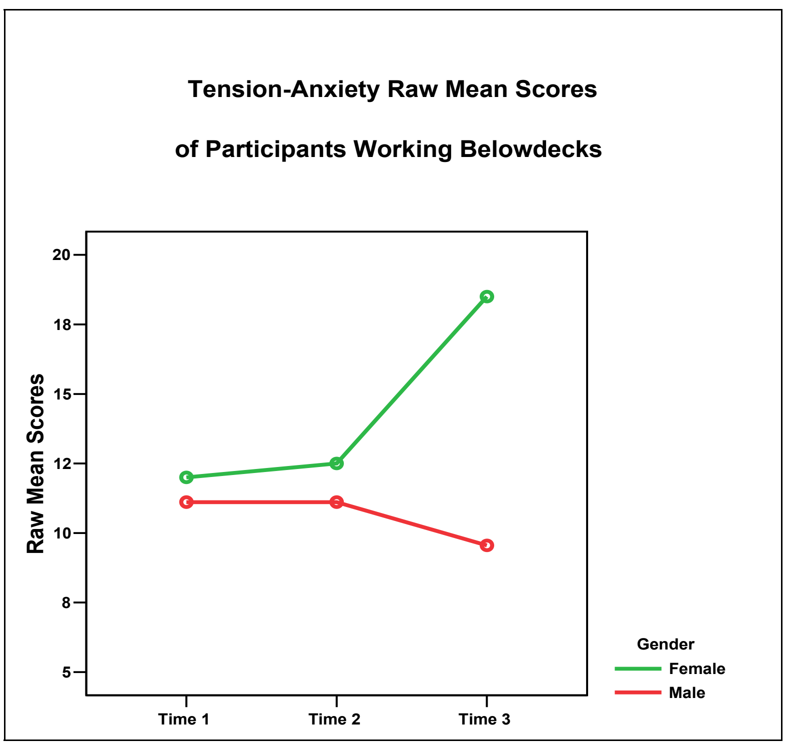

Figure 15. Tension-Anxiety Raw Mean Scores of Participants Working Belowdecks

In another example, there was a significant interaction between time (repeated measures of mood states) and the Total Mood Disturbance (TMD), $F\ (2,19) = 7.783$, $p < 0.01$. The female participants working topside had TMD mean scores at times 1, 2, and 3 of 49.33, 76.67, and 94.00 (*SD*s = 34.27, 51.29, and 62.98, respectively) and the male participants working topside had TMD mean scores at times 1, 2, and 3 of 42.90, 28.00, and 38.40 (*SD*s = 29.03, 33.76, and 25.84, respectively) as shown in Figure 16. In Figure 17, it also showed the female participants working belowdecks had significantly higher TMD scores than male participants working belowdecks. Overall, it was concluded that females have significantly higher Tension-Anxiety, Depression-Dejection, Anger-Hostility, and Fatigue-Inertia scores and significantly lower Vigor-Activity scores than their male counterparts.

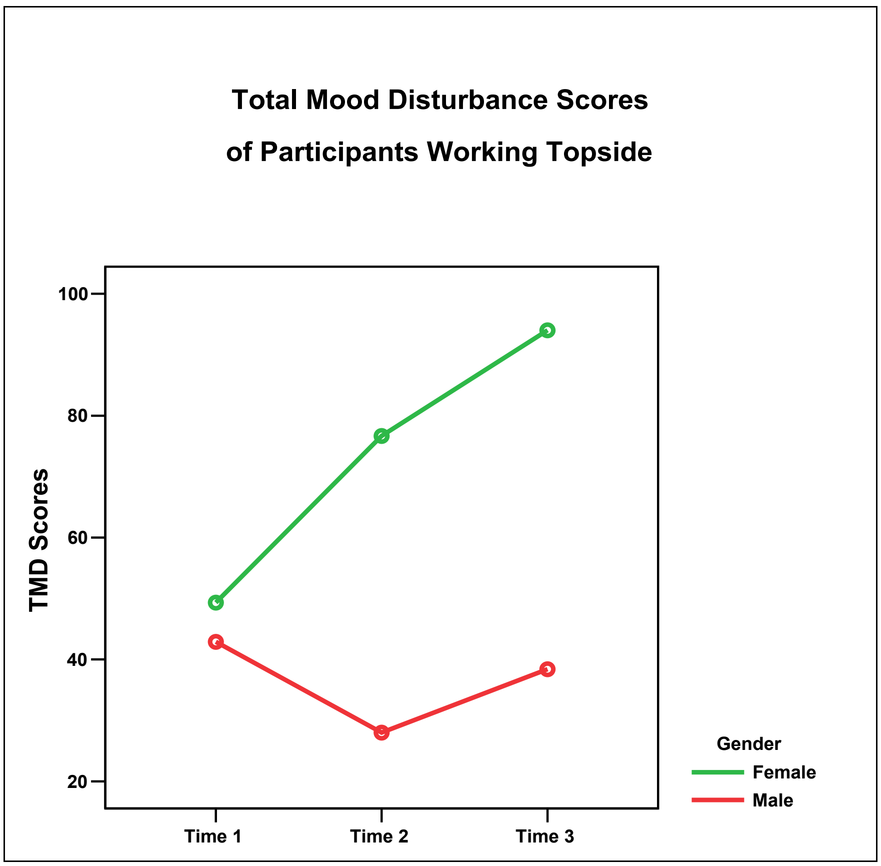

Figure 16. Total Mood Disturbance Scores of Participants Working Topside

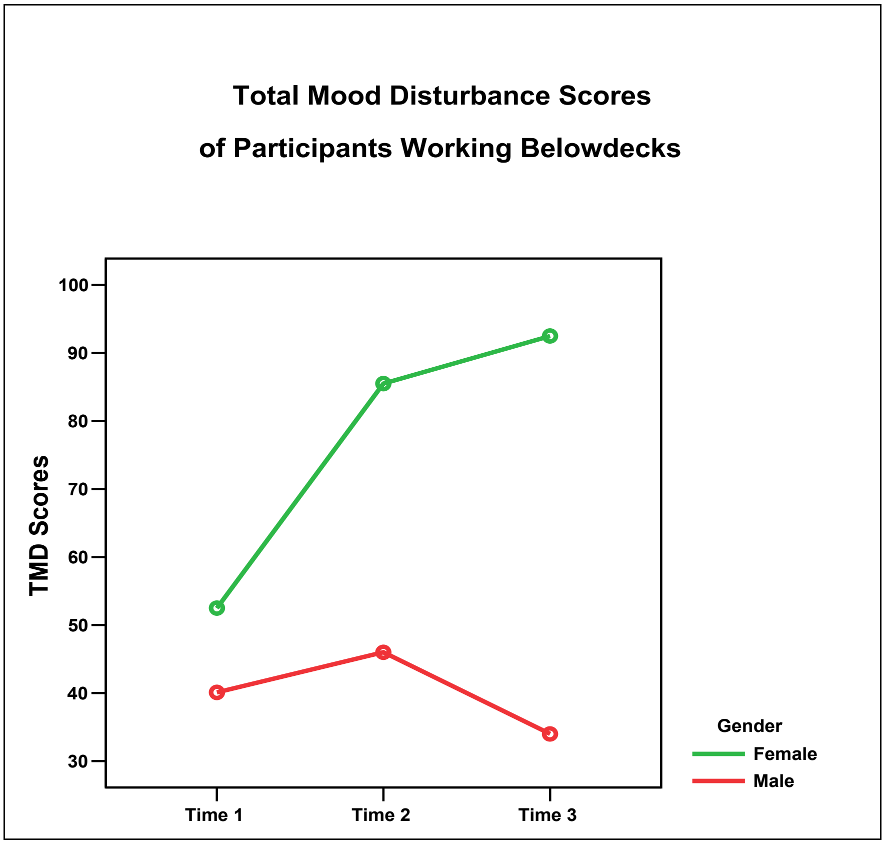

Figure 17. Total Mood Disturbance Scores of Participants Working Belowdecks

The multivariate test was repeated to determine any significant interaction between repeated measures of mood states and workplace. For the five negative mood state factors and the TMD, there was not a significant interaction between the repeated measures of mood states and workplace. However, the positive mood scale factor, Vigor-Activity, did show a significant interaction between the repeated measures of mood state and workplace, $F(2,19) = 3.541$, $p < 0.05$. As shown in Figure 18, the female participants working topside had Vigor-Activity raw mean scores at times 1, 2, and 3 of 17.00, 9.33, and 9.33, SD = 5.03 (*SD*s = 1.73, 5.13, and 5.03, respectively) and the female participants working belowdecks had Vigor-Activity raw mean scores at times 1, 2, and 3 of 13.50, 3.00, and 13.50 (*SD*s = 17.68, 1.41, and 7.78, respectively). Male participants working

topside had Vigor-Activity raw mean scores at times 1, 2, and 3 of 14.80, 16.20, and 16.00 (*SD*s = 2.10, 4.76, and 4.78, respectively) while male participants working belowdecks had Vigor-Activity raw mean scores at times 1, 2, and 3 of 19.11, 15.56, and 21.22 (*SD*s = 6.17, 8.53, and 6.38, respectively) in Figure 19.

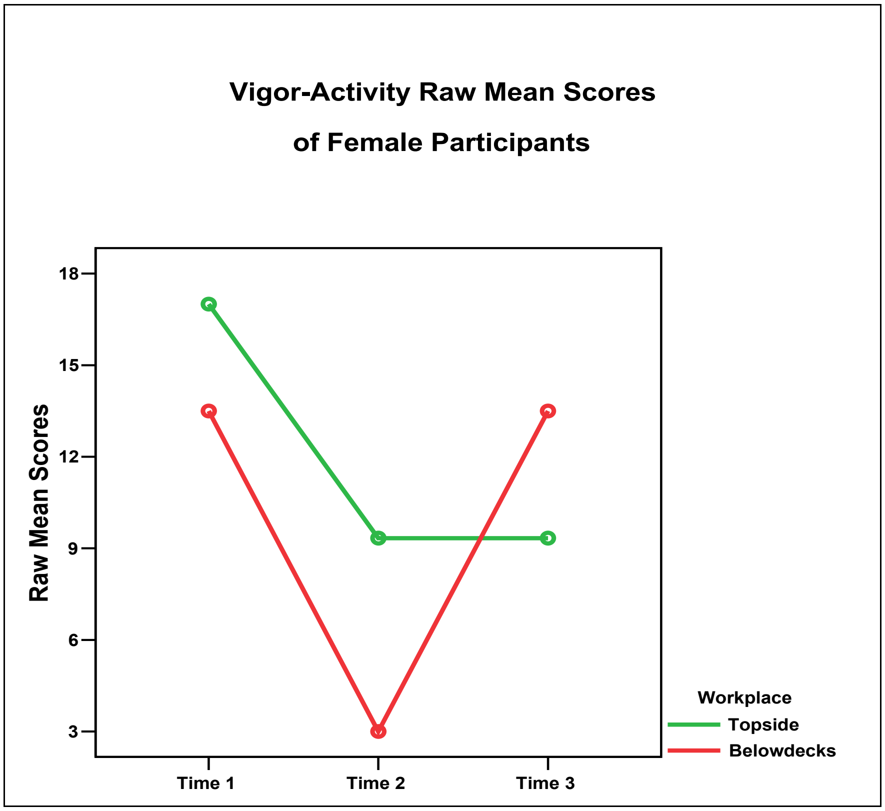

Figure 18. Vigor-Activity Raw Mean Scores of Female Participants

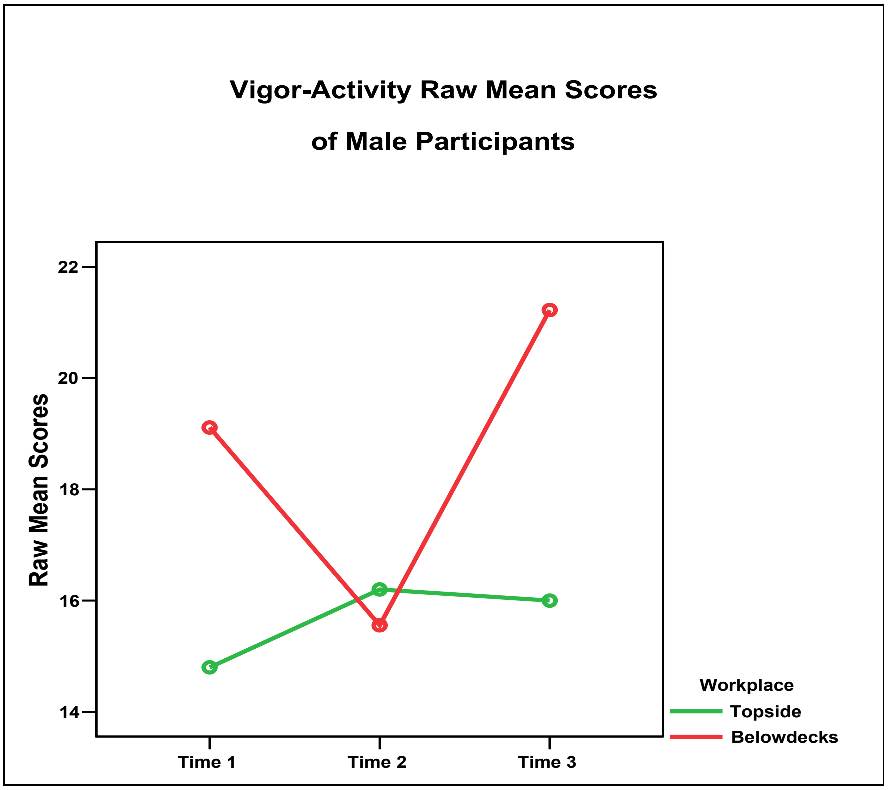

Figure 19. Vigor-Activity Raw Mean Scores of Male Participants

2. Quantity and Quality of Sleep

In addition to the POMS scores, actigraphy data from the participants were also collected for a full 72 hours following 30 days of "night shiftwork." Of the 24 participants, only 18 of them had complete actigraphy data sets. The missing data sets consisted of four males and two females. The average duration of sleep and efficiency was compared to gender, workplace, and the single nightshift time point (time 1).

The average sleep duration of the male and female participants was 5.91 hours, *SD* = 1.50 and 5.36 hours, *SD* = 2.98, respectively. The high variability of the small sample size of females (n = 3) was reflected in Figure 20. With the exception of one female whose average sleep duration was 1.94 hours, females' sleep duration ranged from 6.78 to 7.36. The males sleep duration ranged from 2.12 to 8.32. Pearson correlations were used to test for linear relationships between these variables. The results indicated that there was no linear relationship between sleep duration and gender (r = 0.124, p = 0.625). A previous study by Nguyen (2002) reported that a total of 24 males

and females averaged 6.15 hours and 6.24 hours of sleep per day, respectively, and the difference was not statistically significant (p = 0.92).

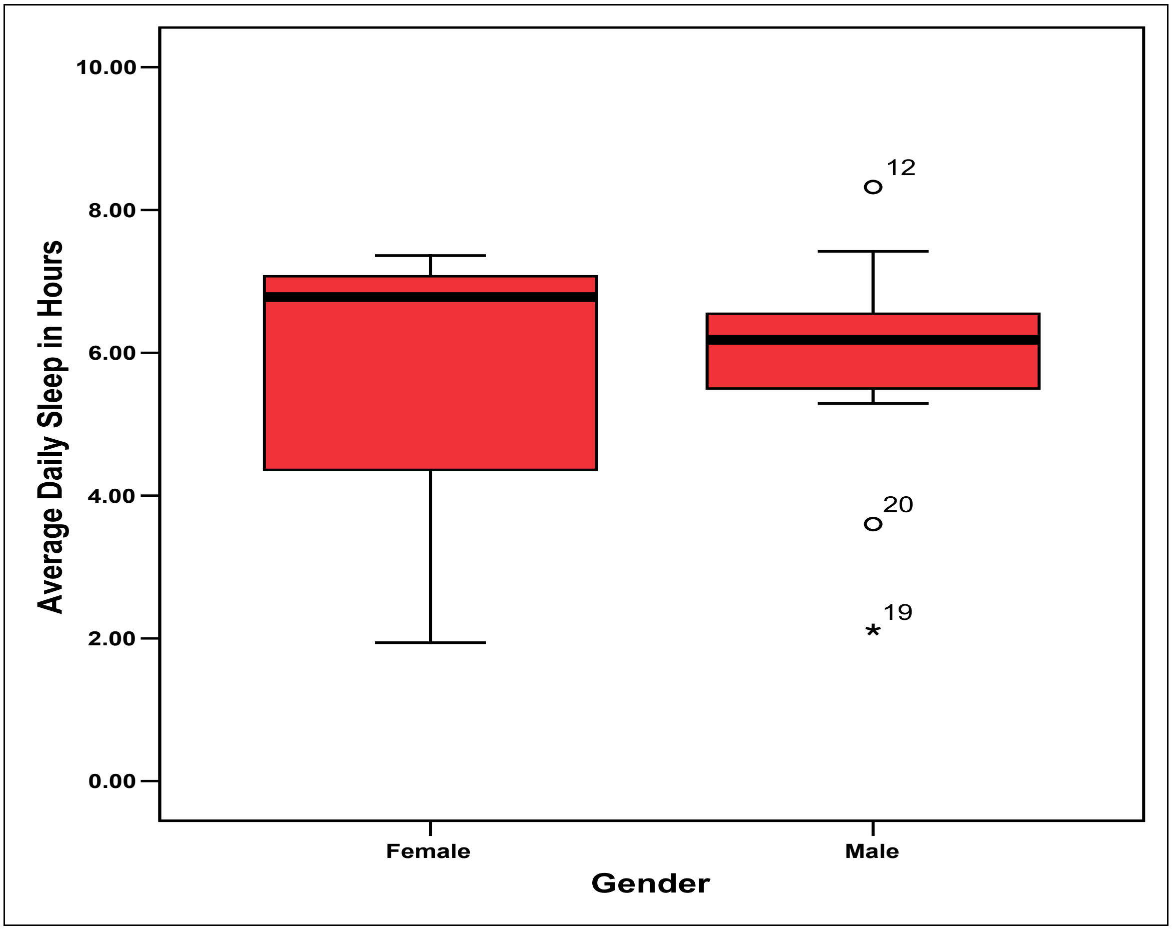

Figure 20. Sleep Duration of Males and Females

Using the Pearson correlation, there was a linear relationship between sleep duration and workplace. The positive correlation coefficient (r = 0.605, p = 0.008) concluded that there is a statistically significant linear relationship between these two variables. As shown in Figure 21, the participants working belowdecks received more sleep than those working topside. The average sleep duration of the topside and belowdecks participants was 4.92 hours, *SD* = 1.75 and 6.95 hours, *SD* = 0.78, respectively. A total of 10 participants (with complete data sets) worked topside and 8 worked belowdecks. This finding confirms the Nguyen study (2002) where the results reported that a total of 24 topside and belowdecks averaged 7.37 hours and 4.74 hours of sleep per day, respectively, and the difference was statistically significant (p = 0.00).

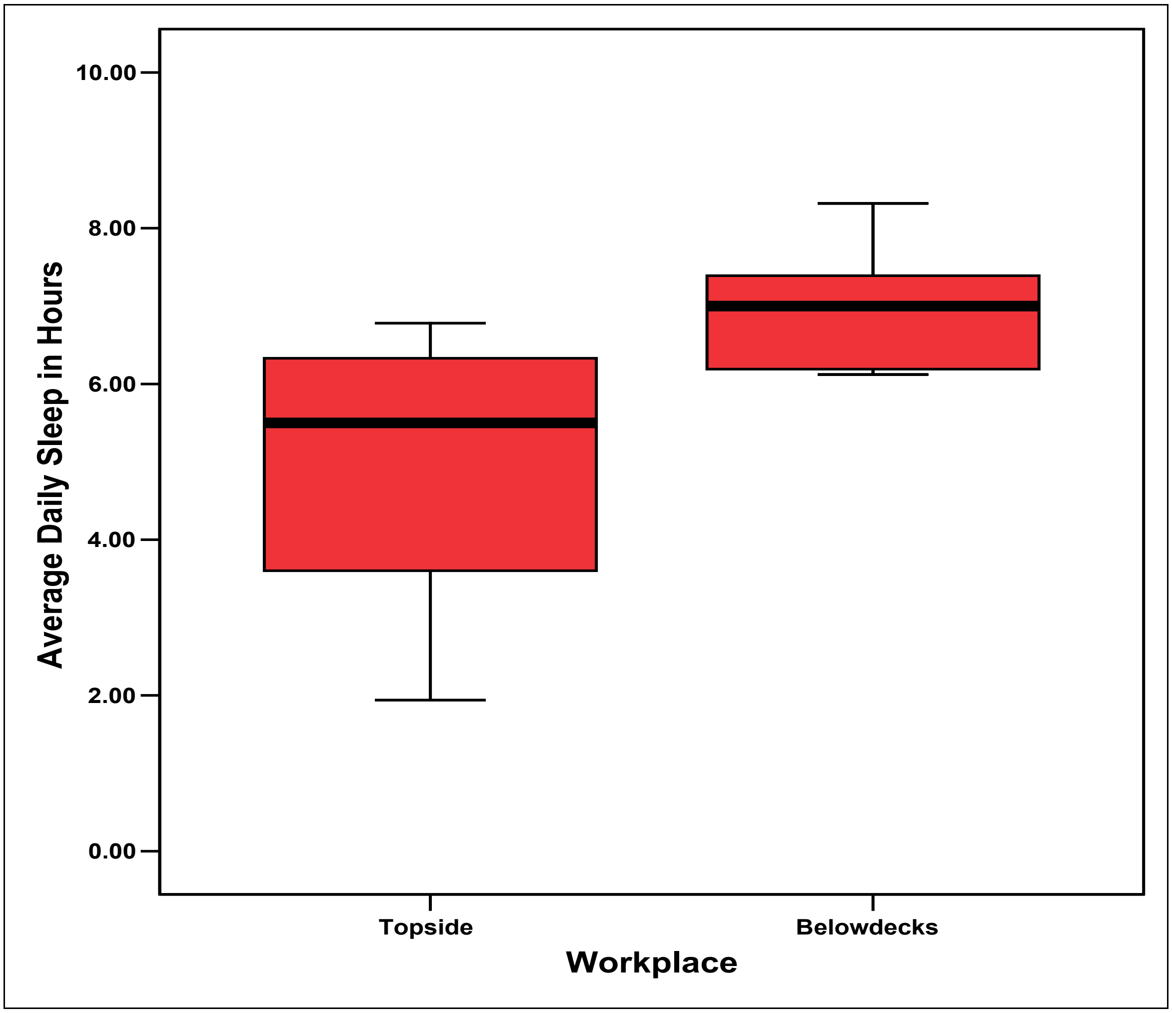

Figure 21. Sleep Duration of Topside and Belowdecks Participants

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V. DISCUSSION AND RECOMMENDATIONS

This study was a follow-up investigation of the effects of reversing sleep-wake cycles on mood, sleep, and fatigue of the crewmembers and Air Wing 9 of the USS JOHN C. STENNIS (CVN-74). The effects of reversing sleep-wake cycle on mood of the crewmembers were analyzed by assessing a repeated administration of the Profile of Mood States (POMS). Mood states were monitored at three time points associated with the current work schedule (night shift vs. day shift) of the crewmembers. There were no significant differences between the mean T scores and the norm at times 1, 2, and 3 for mood scale factors, Tension-Anxiety, Depression-Dejection, and Fatigue-Inertia. It did seem unusual for the majority of the participants to have low Tension-Anxiety T scores during combat. At a heightened level of readiness, one would expect an individual to experience some anxiety. It was also surprising that Depression-Dejection and Fatigue-Inertia were not affected as well since the participants were in combat, working long hours, and disconnected from family and friends. The first POMS reading was administered after 30 days of nightshift work, so it is possible that the participants had adjusted to their working conditions. These participants may have developed a certain level of adaptation to their operational condition, reflecting a similar pattern as seen in the evaluation of sailor's physical and psychological state during prolonged periods of General Quarters study (Burr et al., 1990).

For all three time points, the Anger-Hostility T scores reported were significantly higher than the norm. At time 1, younger participants were angrier than the older participants. Of the sixteen participants in the younger age group, four of the participants were females. It was also found that the Vigor-Activity T scores dropped below the norm at time 2, thus proving that the participants were initially not satisfied with changing shifts. A week later at time 3, Vigor-Activity T scores were back within the norm. Additionally, the analysis showed that the Confusion-Bewilderment T scores were significantly lower than the norm at all three time points.

There was no main effect of repeated measures of mood states over time using the multivariate approach. On the other hand, there was a significant interaction between

repeated measures of mood states and gender. Female participants had significantly higher mood scale scores than the males, indicating an apparent psychological effect on females when sleep-wake cycles are reversed. For positive mood scale factor Vigor-Activity, gender and workplace both had a significant interaction with the repeated measures of mood states. In general, higher vigor scores were found in males and in participants working belowdecks.

Similar to the Nguyen study, the difference between the average sleep duration of male and female participants was not statistically significant. There was however a linear relationship between sleep duration and workplace. Participants working belowdecks received more sleep than those working topside. This finding was not surprising, because the topside participants were exposed to sunlight at the end of their workshift, which causes their melatonin level to decrease, resulting in delayed sleep onset.

For future studies, a larger sample size is needed. In particular, the sample size of males and females should be approximately equal. In the current study, there were a few female participants and these females had a high level of variability. The participants probably may not accurately represent the ship's population, even though great effort was taken to recruit from different departments. Again, males outnumbered the females almost 4 to 1. In addition, a baseline was needed to establish the mood states of the participants before combat. It was possible that the participants gradually adjusted to their present mood states, which were recorded at the three time points. Since the actigraphy data were only collected at time 1, it would have been interesting to see if changes occurred in sleep duration and efficiency at times 2 and 3 as well.

It is recommended that sailors need to be educated on the potential adverse effects of sleep loss and shiftwork on their health and safety. During this time of worldwide unrest, sailors are going to be in combat situations more often. It is important that mood, sleep, and fatigue are monitored properly in order to assess the physiological and psychological state of the crewmembers. With proper sleeping habits enforced, the sailors are more likely to perform at optimal levels and make better decisions.

APPENDIX A. POMS

NAME ______________________ DATE ____________

SEX: Male (M) Female (F)

IDENTIFICATION

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

Col (C) O.P. (O)

Item	NOT AT ALL	A LITTLE	MODERATELY	QUITE A BIT	EXTREMELY
1. Friendly	0	1	2	3	4
2. Tense	0	1	2	3	4
3. Angry	0	1	2	3	4
4. Worn out	0	1	2	3	4
5. Unhappy	0	1	2	3	4
6. Clear-headed	0	1	2	3	4
7. Lively	0	1	2	3	4
8. Confused	0	1	2	3	4
9. Sorry for things done	0	1	2	3	4
10. Shaky	0	1	2	3	4
11. Listless	0	1	2	3	4
12. Peeved	0	1	2	3	4
13. Considerate	0	1	2	3	4
14. Sad	0	1	2	3	4
15. Active	0	1	2	3	4
16. On edge	0	1	2	3	4
17. Grouchy	0	1	2	3	4
18. Blue	0	1	2	3	4
19. Energetic	0	1	2	3	4
20. Panicky	0	1	2	3	4
21. Hopeless	0	1	2	3	4
22. Relaxed	0	1	2	3	4
23. Unworthy	0	1	2	3	4
24. Spiteful	0	1	2	3	4
25. Sympathetic	0	1	2	3	4
26. Uneasy	0	1	2	3	4
27. Restless	0	1	2	3	4
28. Unable to concentrate	0	1	2	3	4
29. Fatigued	0	1	2	3	4
30. Helpful	0	1	2	3	4
31. Annoyed	0	1	2	3	4
32. Discouraged	0	1	2	3	4
33. Resentful	0	1	2	3	4
34. Nervous	0	1	2	3	4
35. Lonely	0	1	2	3	4
36. Miserable	0	1	2	3	4
37. Muddled	0	1	2	3	4
38. Cheerful	0	1	2	3	4
39. Bitter	0	1	2	3	4
40. Exhausted	0	1	2	3	4
41. Anxious	0	1	2	3	4
42. Ready to fight	0	1	2	3	4
43. Good natured	0	1	2	3	4
44. Gloomy	0	1	2	3	4
45. Desperate	0	1	2	3	4
46. Sluggish	0	1	2	3	4
47. Rebellious	0	1	2	3	4
48. Helpless	0	1	2	3	4
49. Weary	0	1	2	3	4
50. Bewildered	0	1	2	3	4
51. Alert	0	1	2	3	4
52. Deceived	0	1	2	3	4
53. Furious	0	1	2	3	4
54. Efficient	0	1	2	3	4
55. Trusting	0	1	2	3	4
56. Full of pep	0	1	2	3	4
57. Bad-tempered	0	1	2	3	4
58. Worthless	0	1	2	3	4
59. Forgetful	0	1	2	3	4
60. Carefree	0	1	2	3	4
61. Terrified	0	1	2	3	4
62. Guilty	0	1	2	3	4
63. Vigorous	0	1	2	3	4
64. Uncertain about things	0	1	2	3	4
65. Bushed	0	1	2	3	4

MAKE SURE YOU HAVE ANSWERED EVERY ITEM.

POM 021

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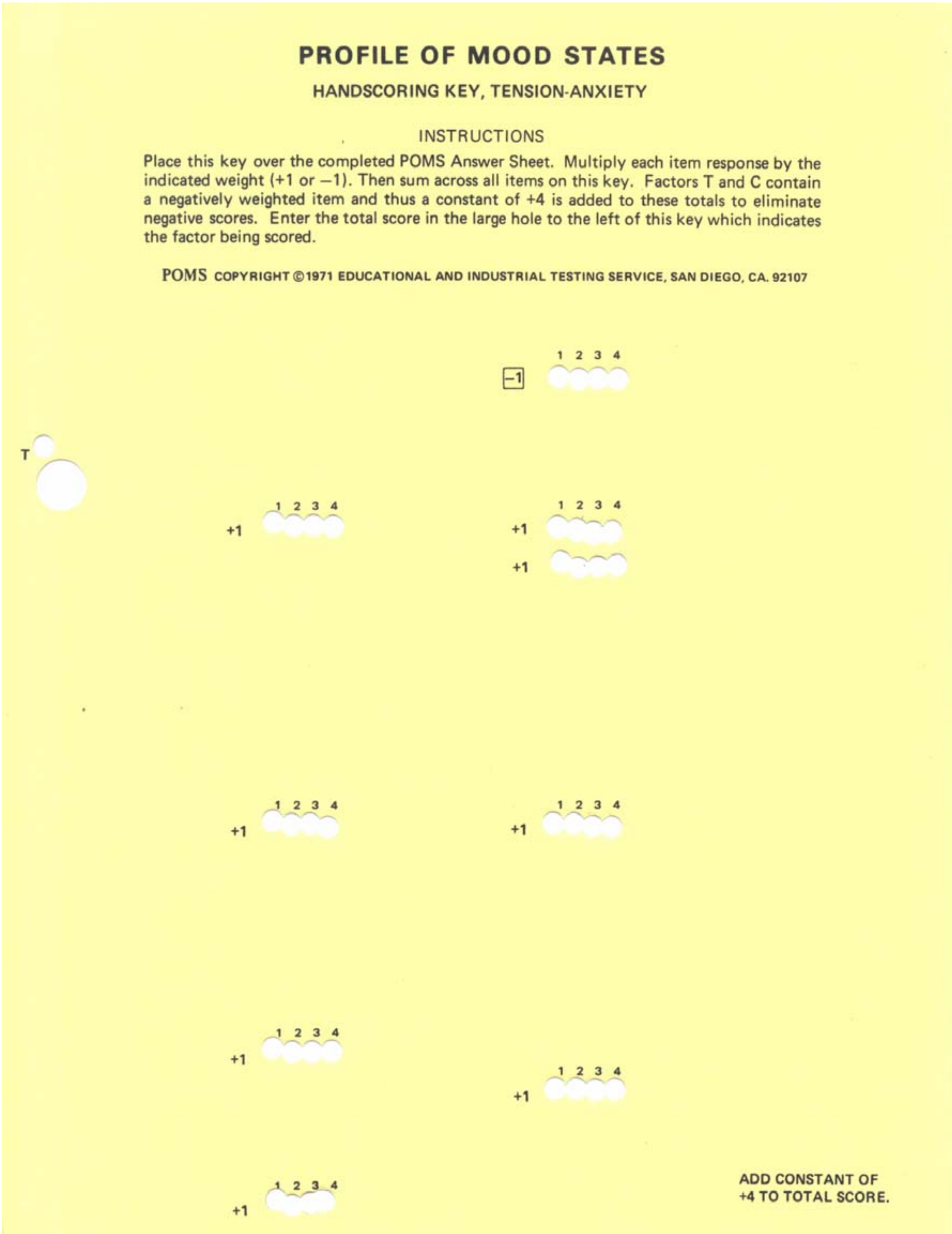
APPENDIX B. TENSION-ANXIETY HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, TENSION-ANXIETY

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

1 2 3 4
−1

T

1 2 3 4
+1

1 2 3 4
+1
+1

1 2 3 4
+1

1 2 3 4
+1

1 2 3 4
+1

1 2 3 4
+1

1 2 3 4
+1

ADD CONSTANT OF
+4 TO TOTAL SCORE.

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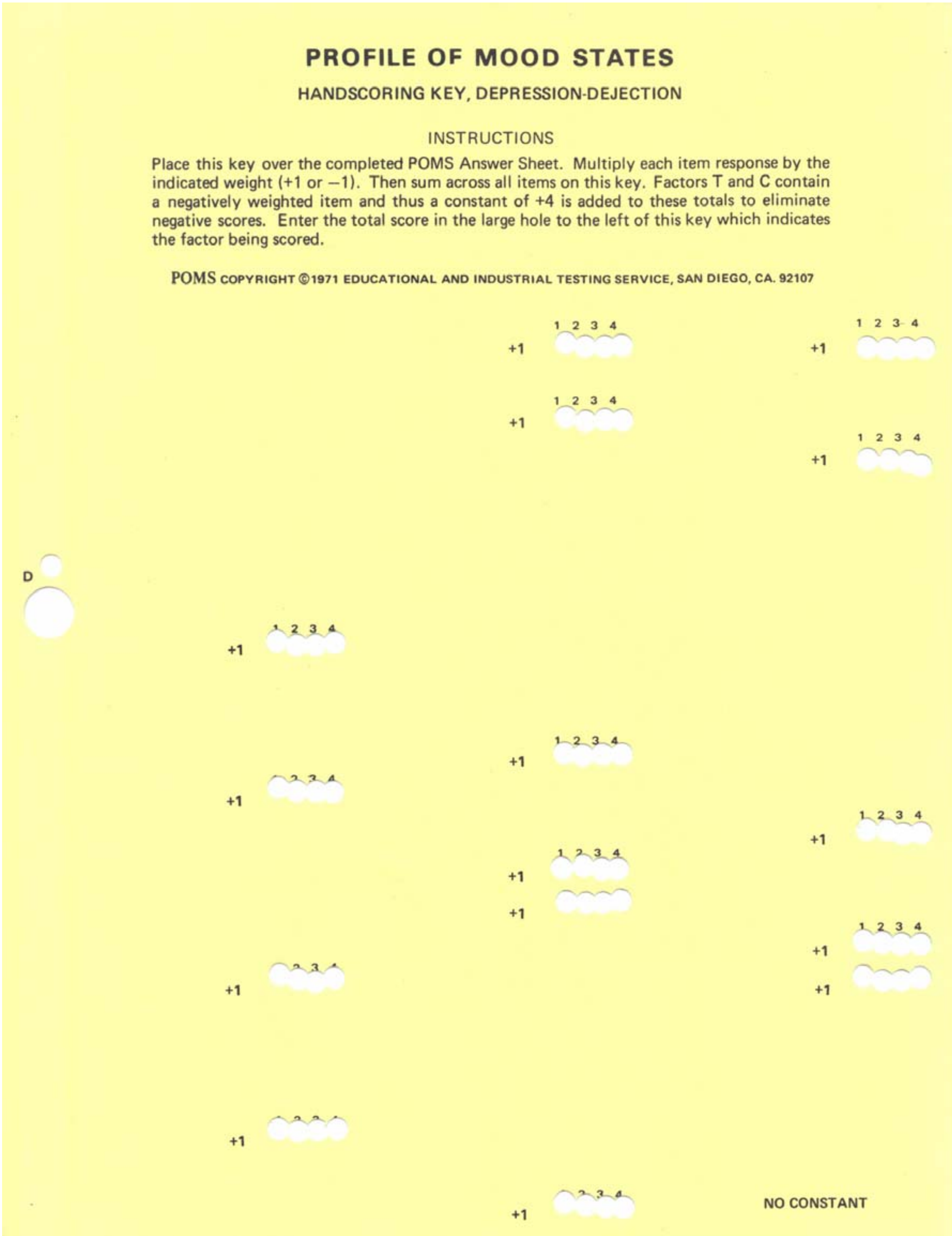
APPENDIX C. DEPRESSION-DEJECTION HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, DEPRESSION-DEJECTION

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

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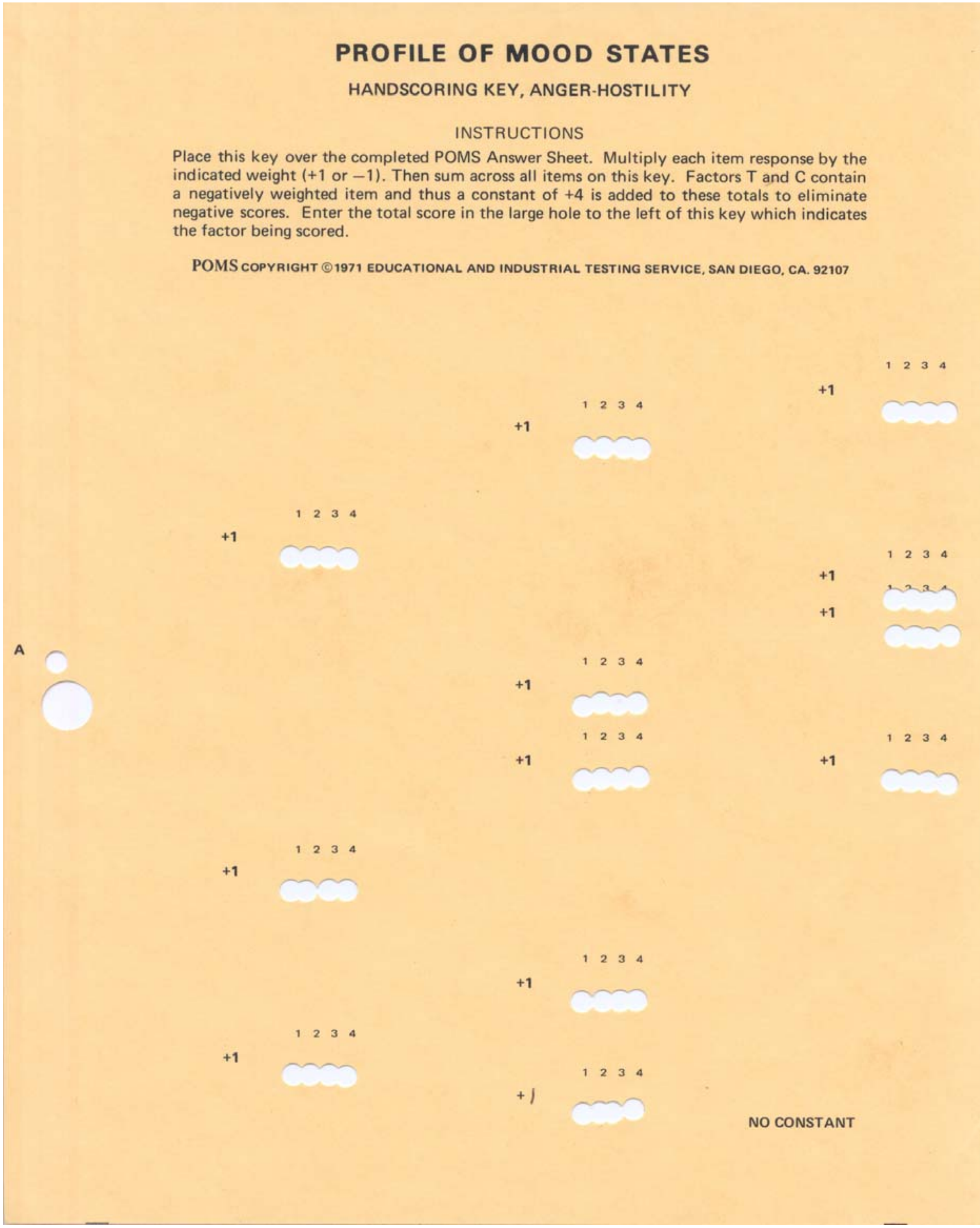
APPENDIX D. ANGER-HOSTILITY HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, ANGER-HOSTILITY

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

A

NO CONSTANT

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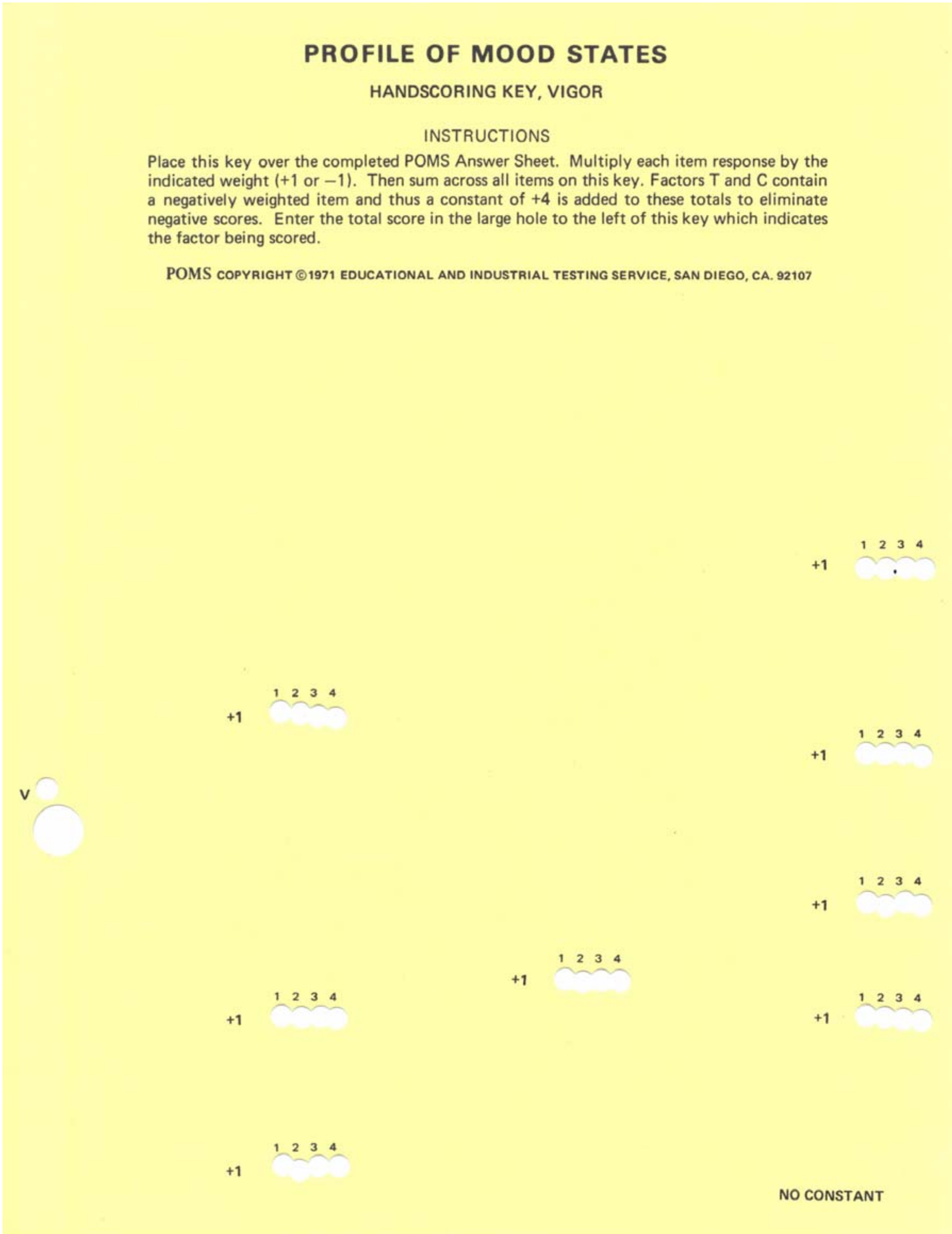
APPENDIX E. VIGOR-ACTIVITY HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, VIGOR

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

NO CONSTANT

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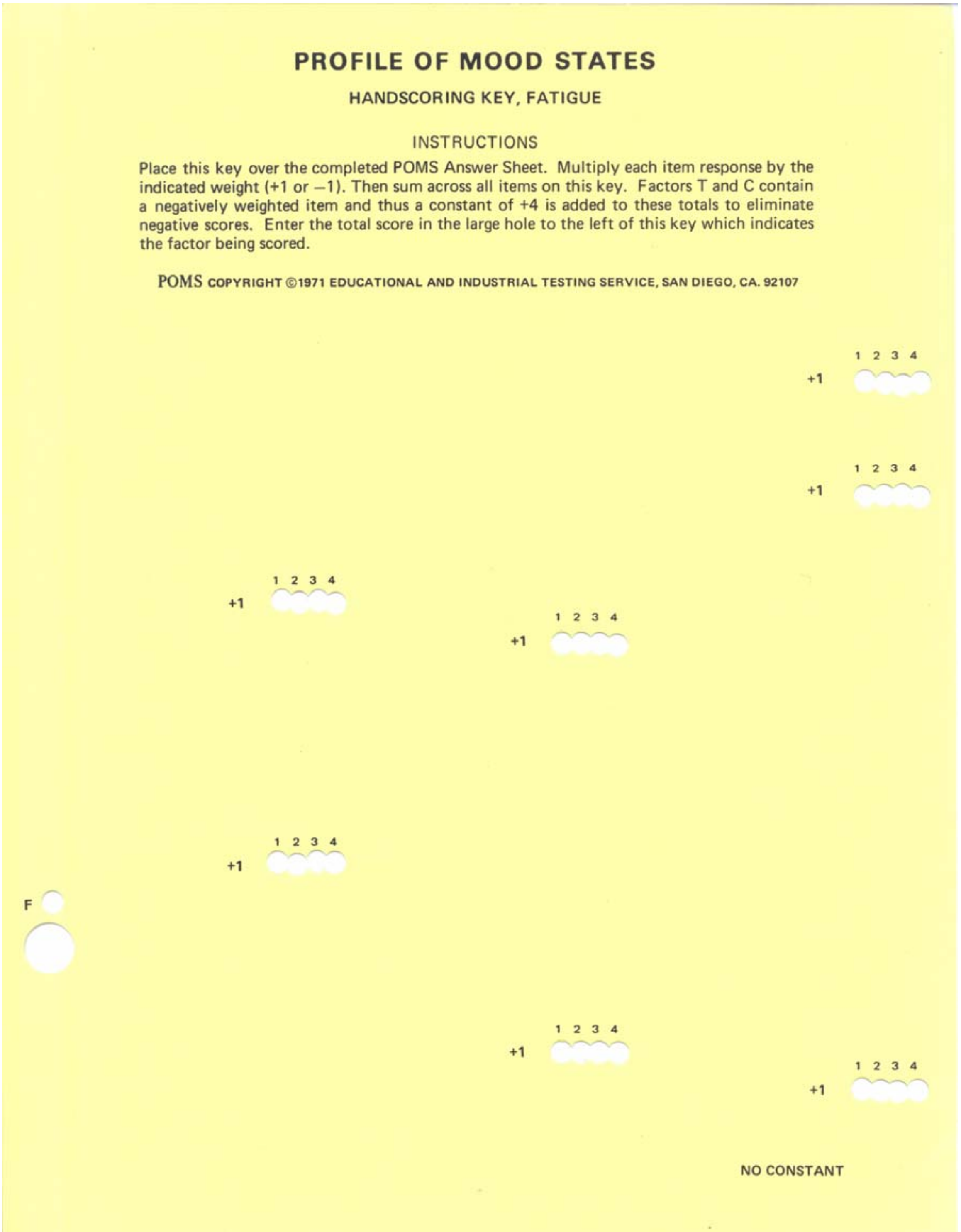
APPENDIX F. FATIGUE-INERTIA HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, FATIGUE

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

+1 1 2 3 4

+1 1 2 3 4

+1 1 2 3 4

+1 1 2 3 4

+1 1 2 3 4

F

+1 1 2 3 4

+1 1 2 3 4

NO CONSTANT

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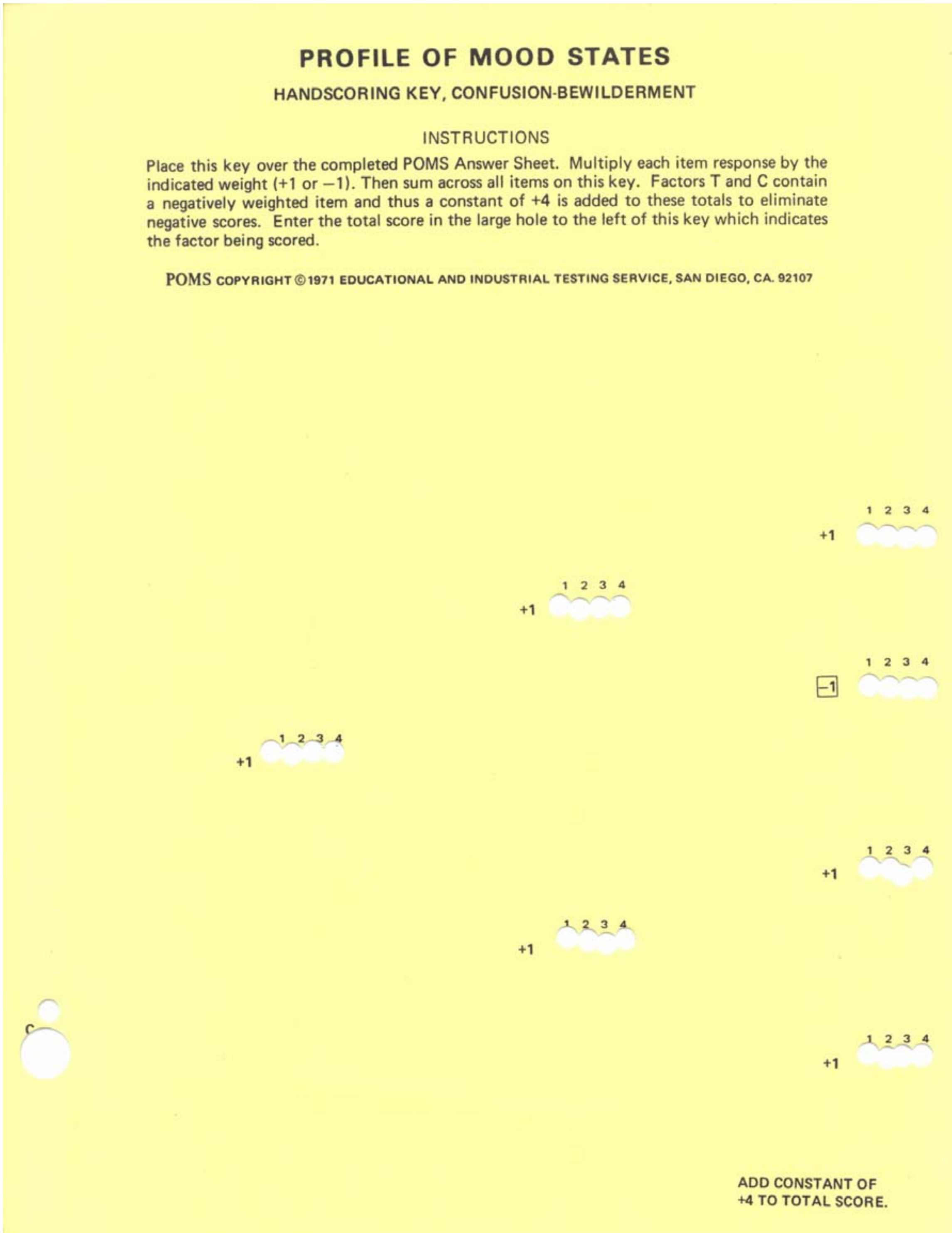
APPENDIX G. CONFUSION-BEWILDERMENT HANDSCORING KEY



PROFILE OF MOOD STATES

HANDSCORING KEY, CONFUSION-BEWILDERMENT

INSTRUCTIONS

Place this key over the completed POMS Answer Sheet. Multiply each item response by the indicated weight (+1 or −1). Then sum across all items on this key. Factors T and C contain a negatively weighted item and thus a constant of +4 is added to these totals to eliminate negative scores. Enter the total score in the large hole to the left of this key which indicates the factor being scored.

+1 1 2 3 4

+1 1 2 3 4

−1 1 2 3 4

+1 1 2 3 4

+1 1 2 3 4

+1 1 2 3 4

C

+1 1 2 3 4

ADD CONSTANT OF +4 TO TOTAL SCORE.

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APPENDIX H. COLLEGE STUDENT NORMS

T Score Norms for College Students
(N=856)[a]

POMS Factor

Raw Score (X)	T	D	A	V	F	C	Raw Score (X)	Raw Score (X)	T	D	A	V	F	C	Raw Score (X)
0	31	37	37	26	34	30	0	31	74	65	78	74			31
1	33	38	39	27	35	32	1	32	76	66	80	76			32
2	34	39	40	29	37	33	2	33	77	67	81				33
3	35	40	41	30	38	35	3	34	79	68	82				34
4	37	41	42	32	40	37	4	35	80	69	84				35
5	38	42	44	33	41	39	5	36	81	70	85				36
6	40	43	45	35	43	41	6	37		71	86				37
7	41	44	47	37	45	43	7	38		72	87				38
8	42	44	48	38	46	44	8	39		72	89				39
9	43	45	49	40	48	46	9	40		73	90				40
10	45	46	51	41	49	48	10	41		74	91				41
11	47	47	52	43	51	50	11	42		75	93				42
12	48	48	53	44	52	52	12	43		76	94				43
13	49	49	54	46	54	53	13	44		77	95				44
14	51	50	56	48	55	55	14	45		78	97				45
15	52	51	57	49	57	57	15	46		79	98				46
16	54	52	58	51	58	59	16	47		80	99				47
17	55	53	60	52	60	61	17	48		81	101				48
18	56	53	61	54	61	63	18	49		81					49
19	58	54	62	55	63	64	19	50		82					50
20	59	55	64	57	64	66	20	51		83					51
21	60	56	65	59	66	68	21	52		84					52
22	62	57	66	60	67	70	22	53		85					53
23	63	58	68	62	69	72	23	54		86					54
24	65	59	69	63	70	73	24	55		87					55
25	66	60	70	65	72	75	25	56		88					56
26	67	61	72	66	73	77	26	57		89					57
27	69	62	73	68	75	79	27	58		90					58
28	70	63	74	70	77	81	28	59		90					59
29	72	63	76	71			29	60		91					60
30	73	64	77	73			30								

[a] $T = 50 + 10\,[(X - M)/s]$

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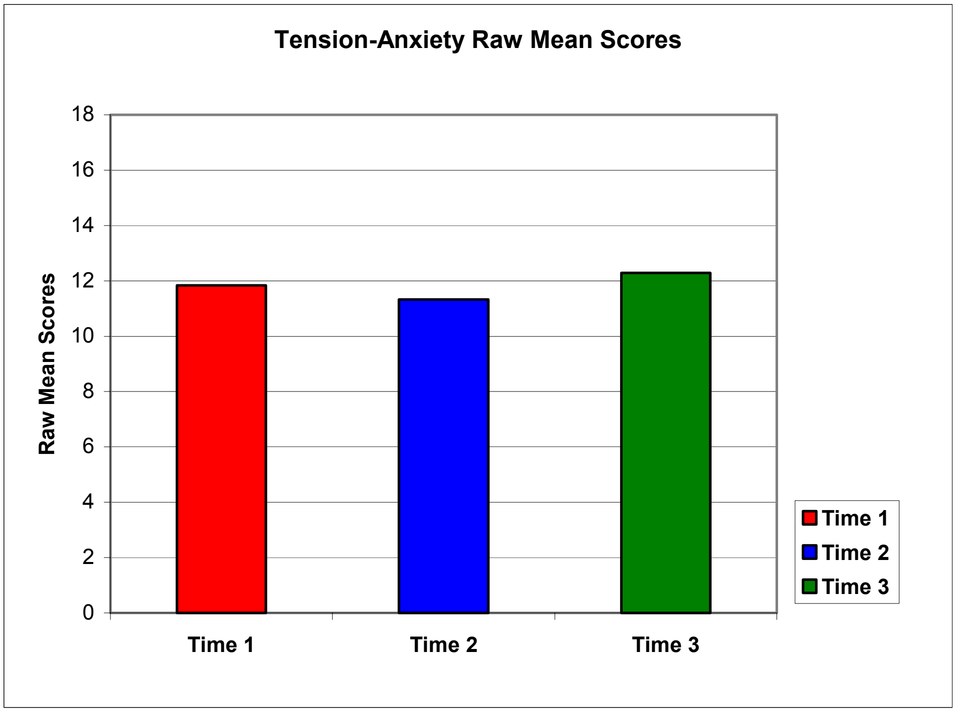
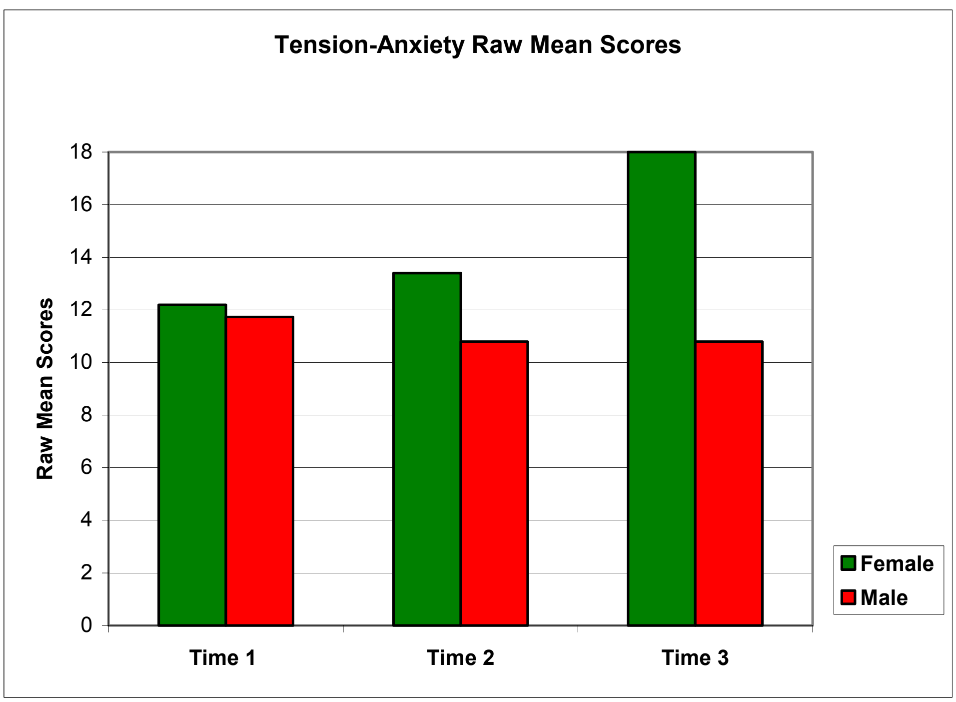
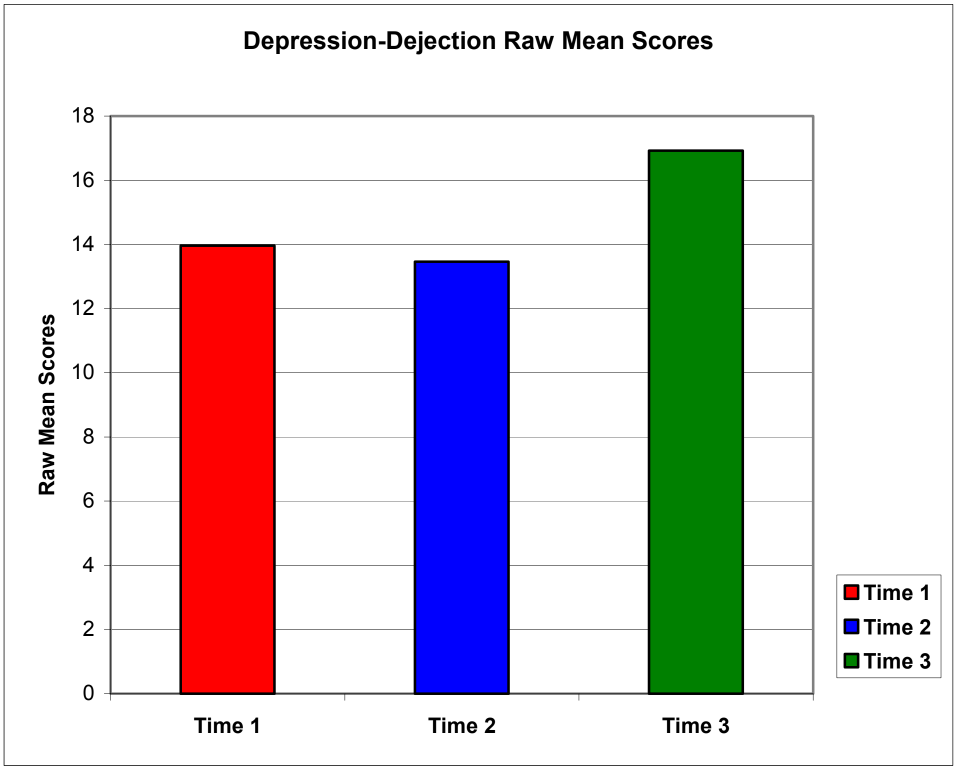
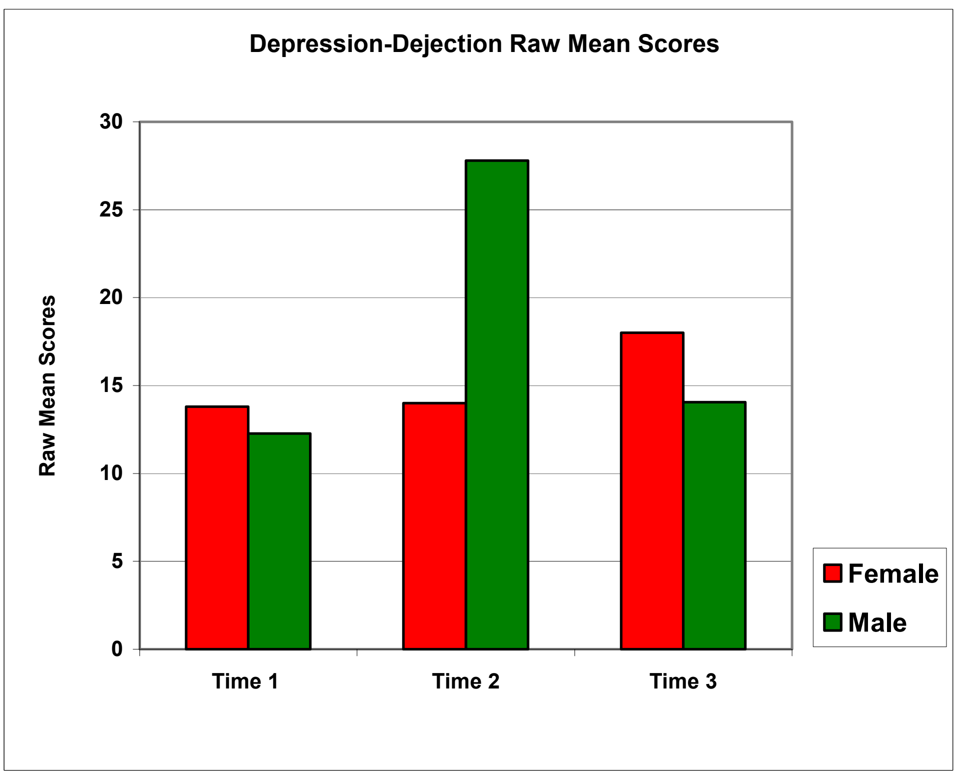
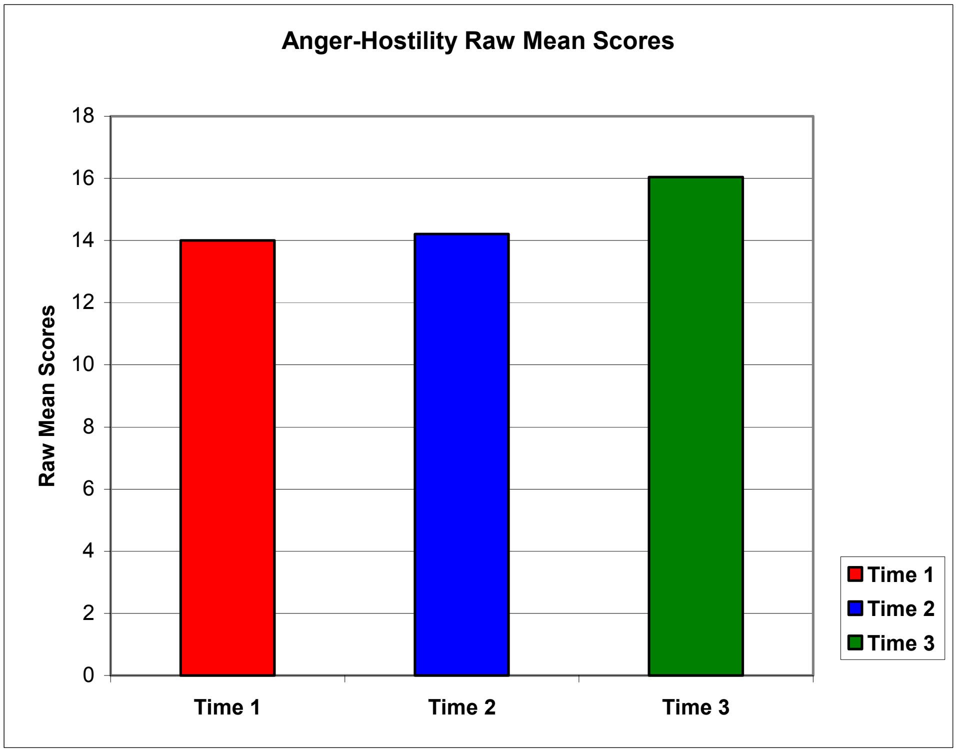
APPENDIX I. RAW POMS SCORES

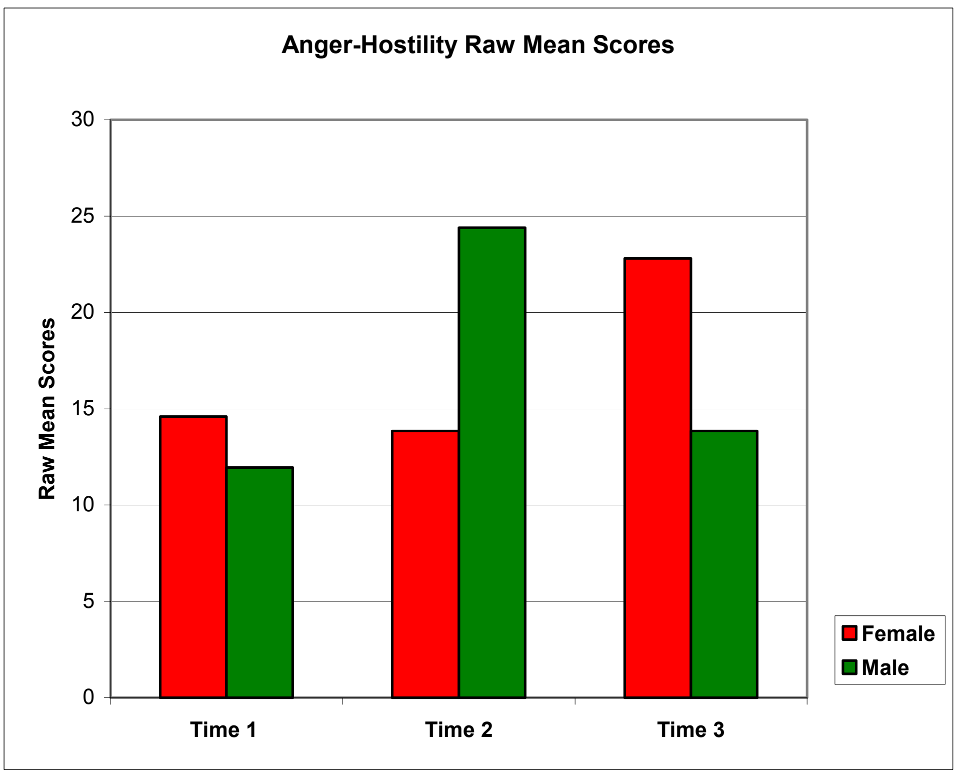


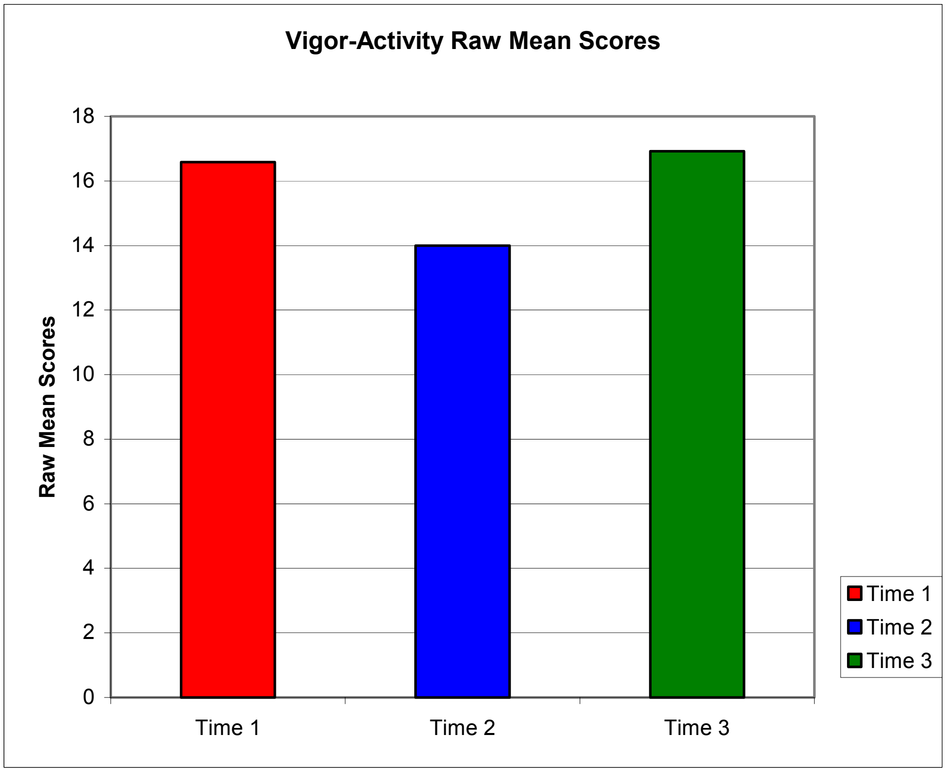


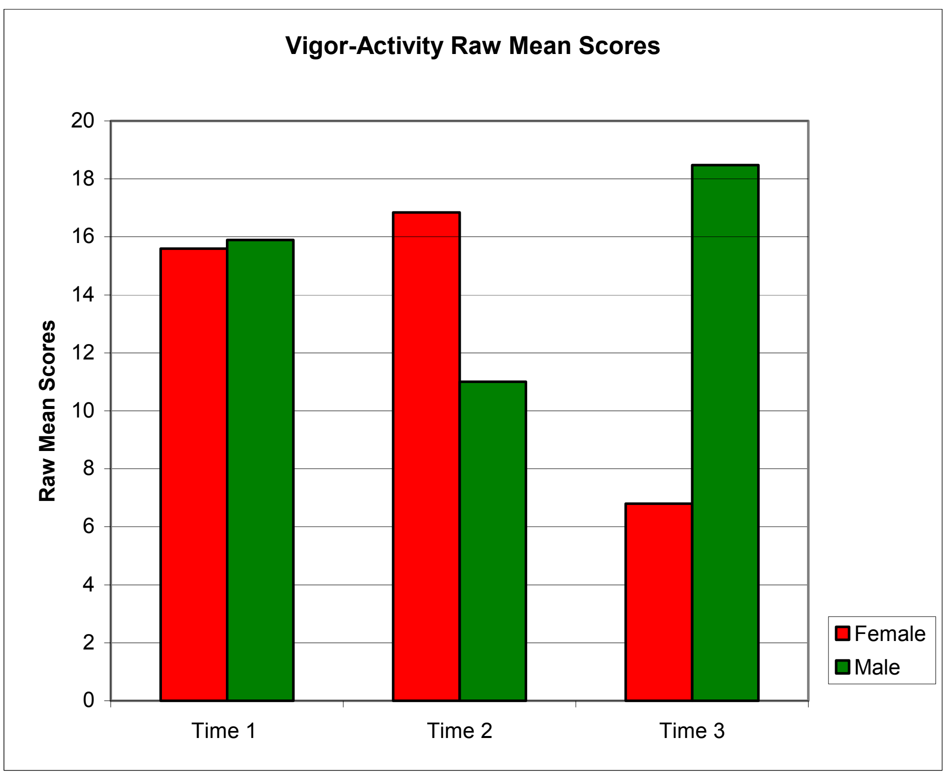

Depression-Dejection Raw Mean Scores
Raw Mean Scores
0
2
4
6
8
10
12
14
16
18
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3

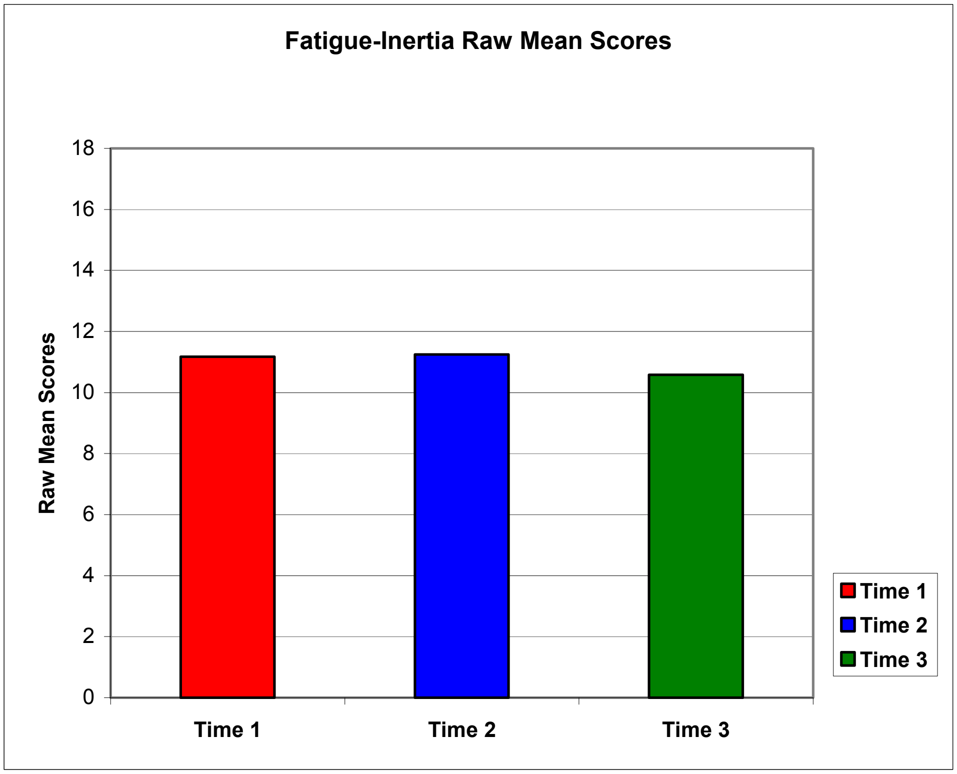

Depression-Dejection Raw Mean Scores
Raw Mean Scores
0
5
10
15
20
25
30
Time 1
Time 2
Time 3
Female
Male

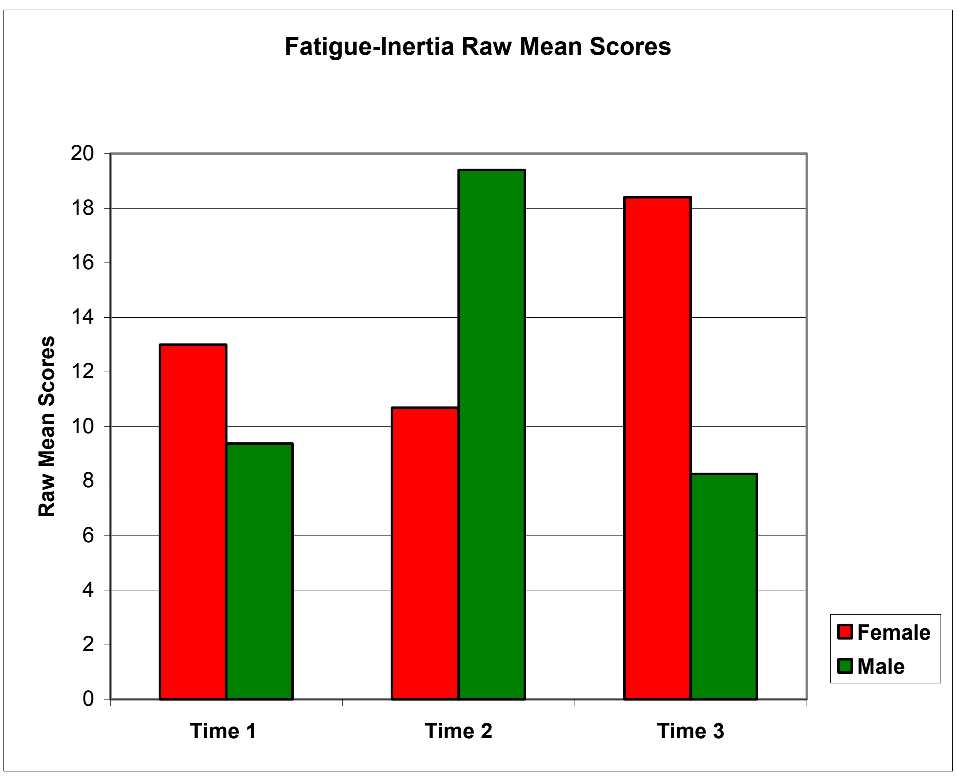

Anger-Hostility Raw Mean Scores
Raw Mean Scores
18
16
14
12
10
8
6
4
2
0
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3

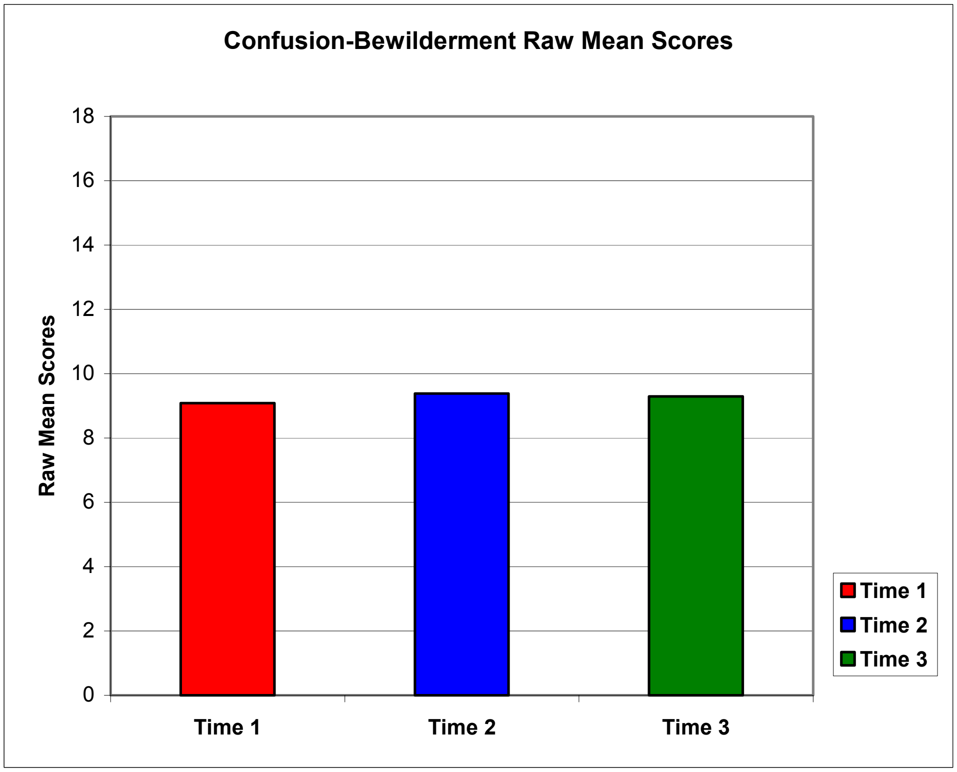

Anger-Hostility Raw Mean Scores
Raw Mean Scores
30
25
20
15
10
5
0
Time 1
Time 2
Time 3
Female
Male

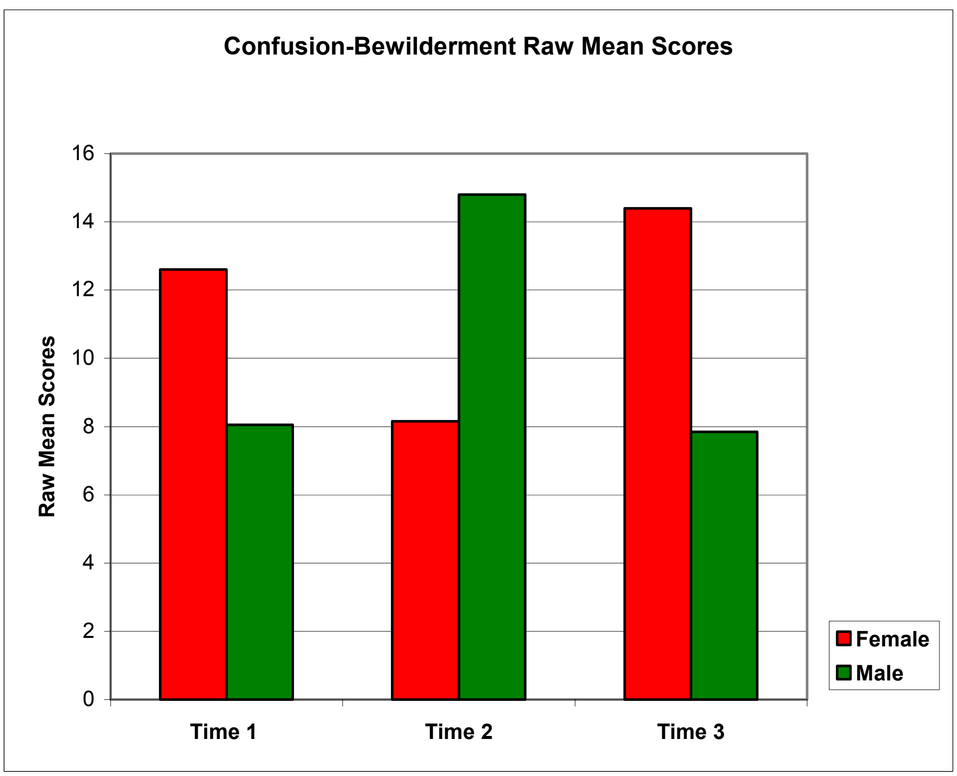

Vigor-Activity Raw Mean Scores
Raw Mean Scores
0
2
4
6
8
10
12
14
16
18
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3

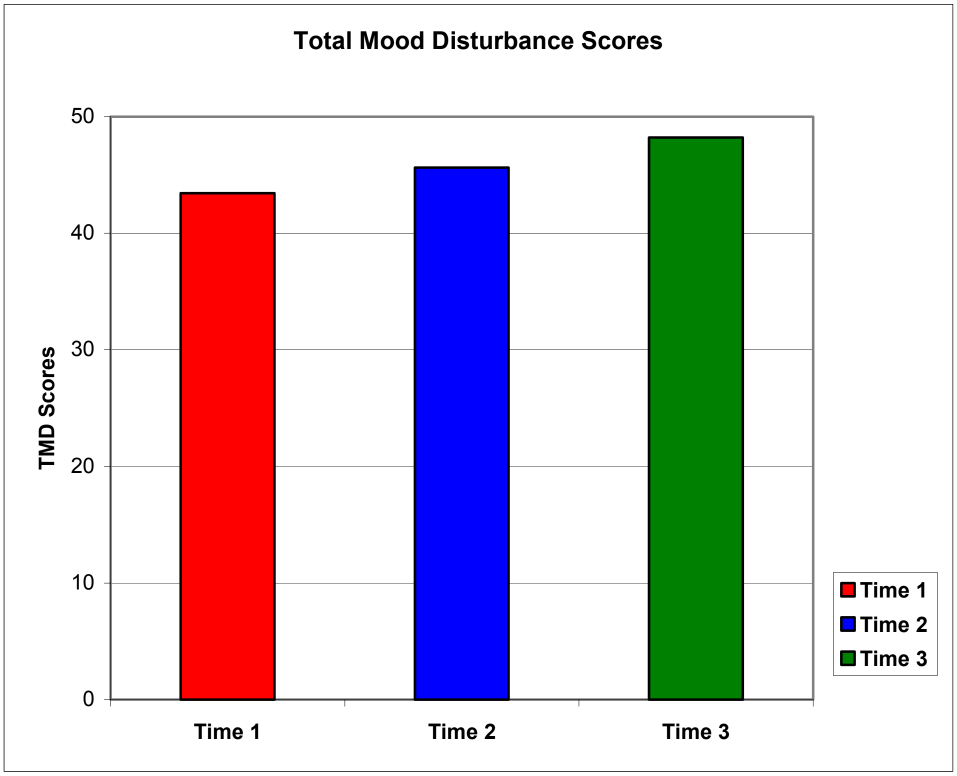

Vigor-Activity Raw Mean Scores
Raw Mean Scores
0
2
4
6
8
10
12
14
16
18
20
Time 1
Time 2
Time 3
Female
Male

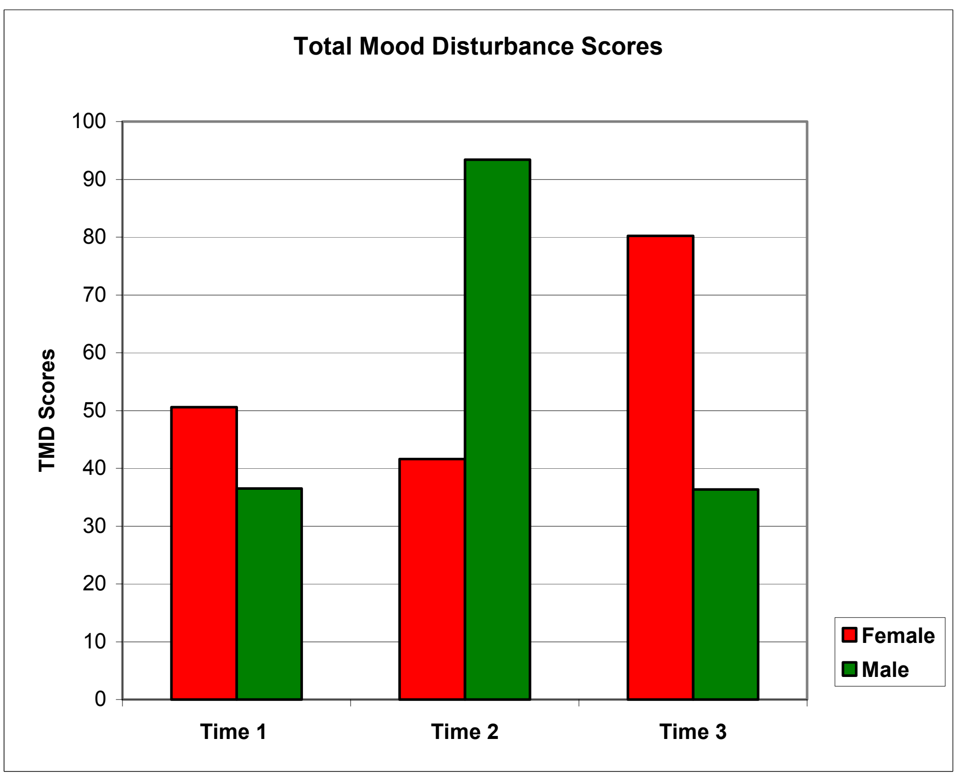

Fatigue-Inertia Raw Mean Scores
Raw Mean Scores
18
16
14
12
10
8
6
4
2
0
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3


Fatigue-Inertia Raw Mean Scores
Raw Mean Scores
20
18
16
14
12
10
8
6
4
2
0
Time 1
Time 2
Time 3
Female
Male


Confusion-Bewilderment Raw Mean Scores
Raw Mean Scores
18
16
14
12
10
8
6
4
2
0
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3


Confusion-Bewilderment Raw Mean Scores
Raw Mean Scores
16
14
12
10
8
6
4
2
0
Time 1
Time 2
Time 3
Female
Male


Total Mood Disturbance Scores
TMD Scores
50
40
30
20
10
0
Time 1
Time 2
Time 3
Time 1
Time 2
Time 3


Total Mood Disturbance Scores
TMD Scores
100
90
80
70
60
50
40
30
20
10
0
Time 1
Time 2
Time 3
Female
Male

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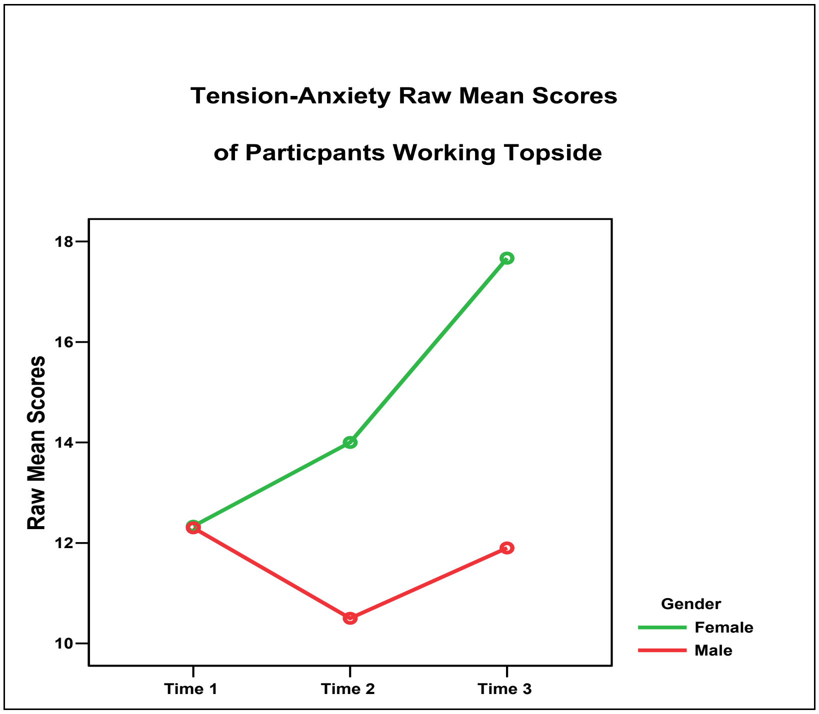
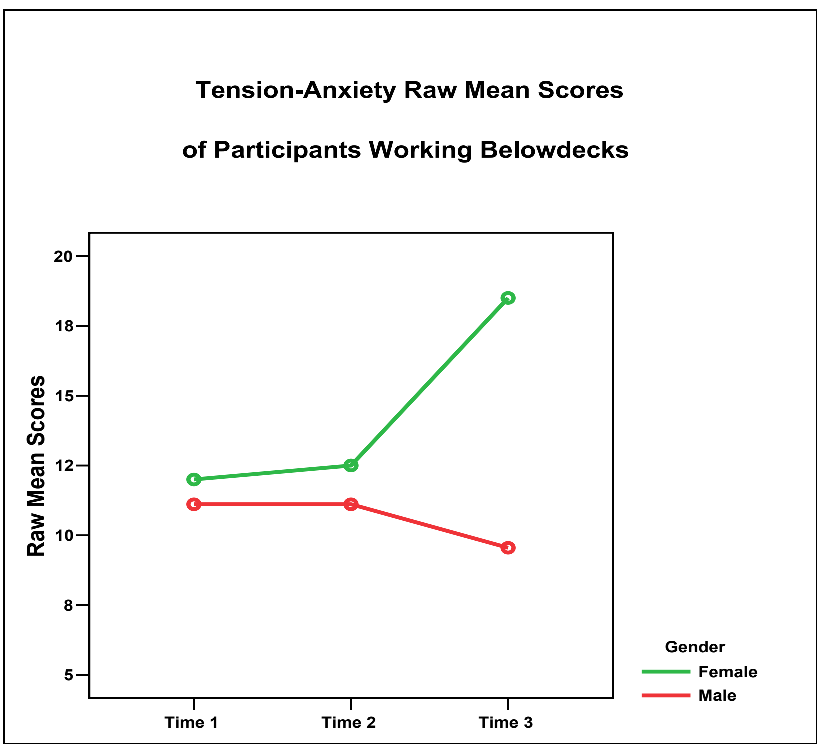
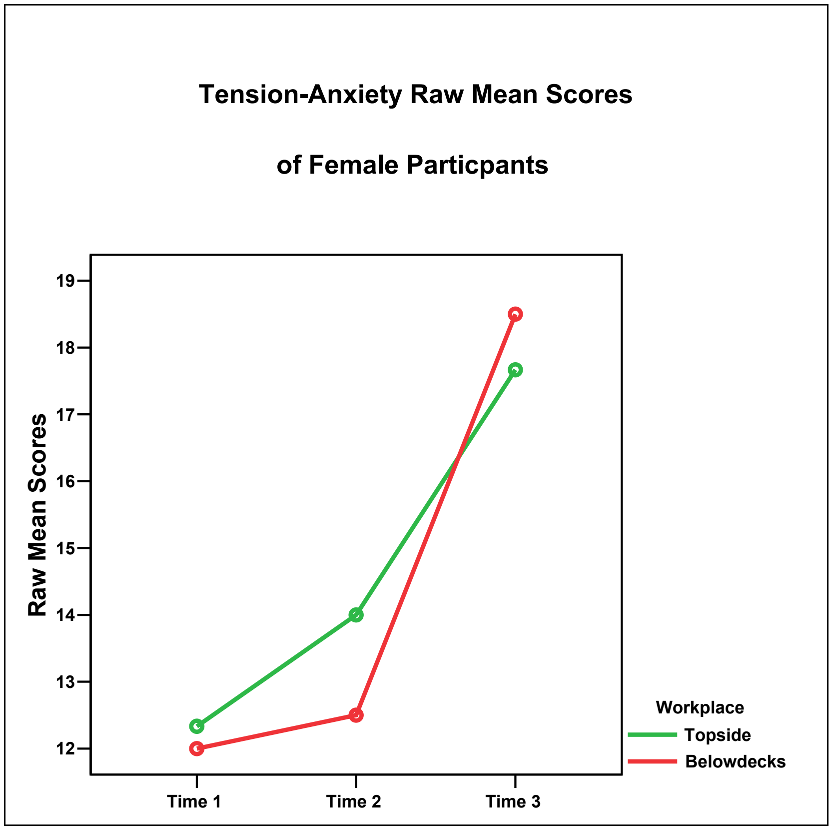
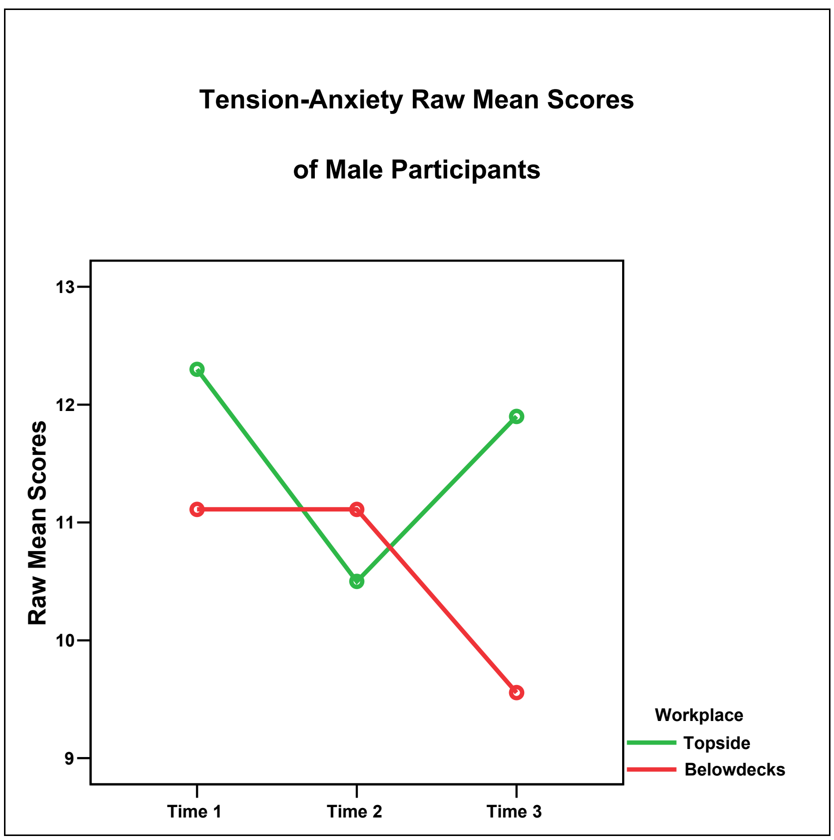
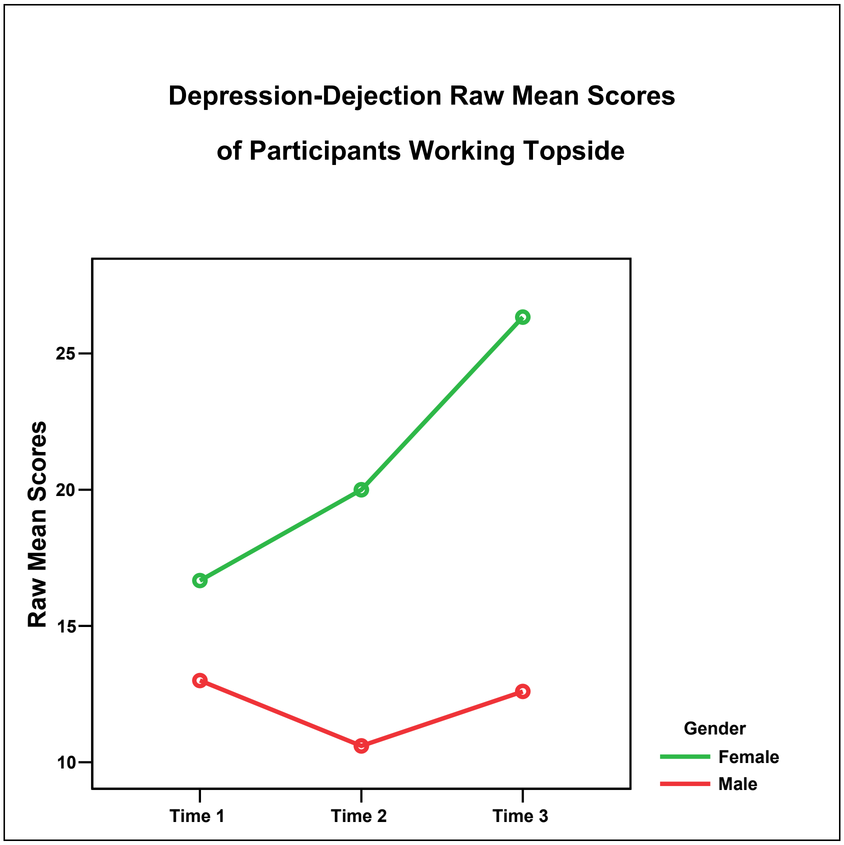
APPENDIX J. PLOTS OF GENDER AND WORKPLACE OVER THREE REPEATED ADMINISTRATIONS OF POMS SCORES

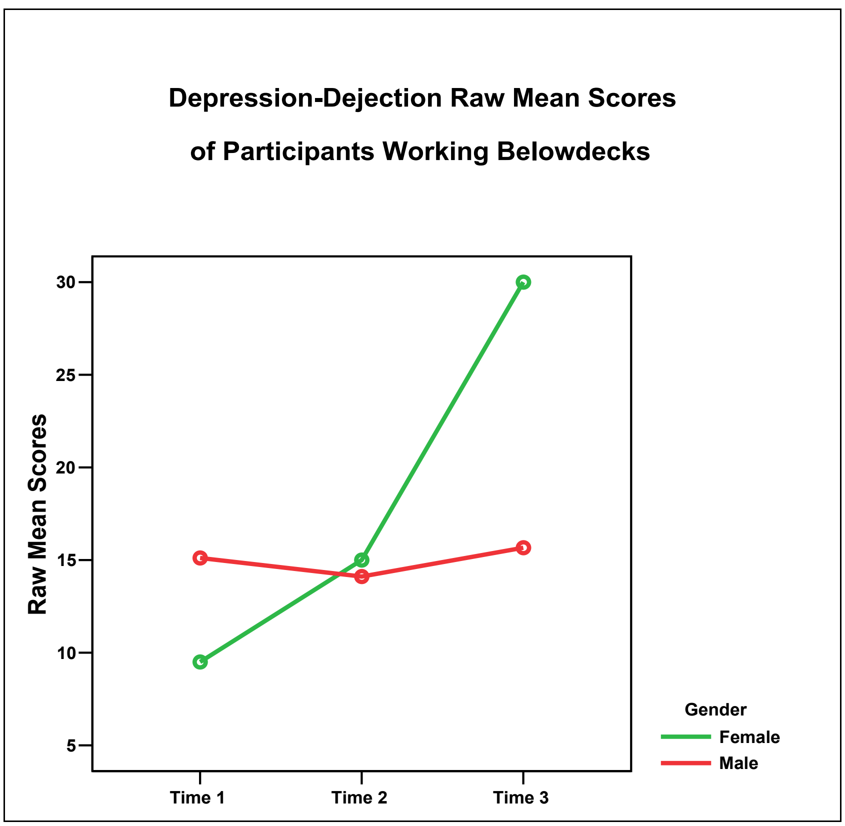


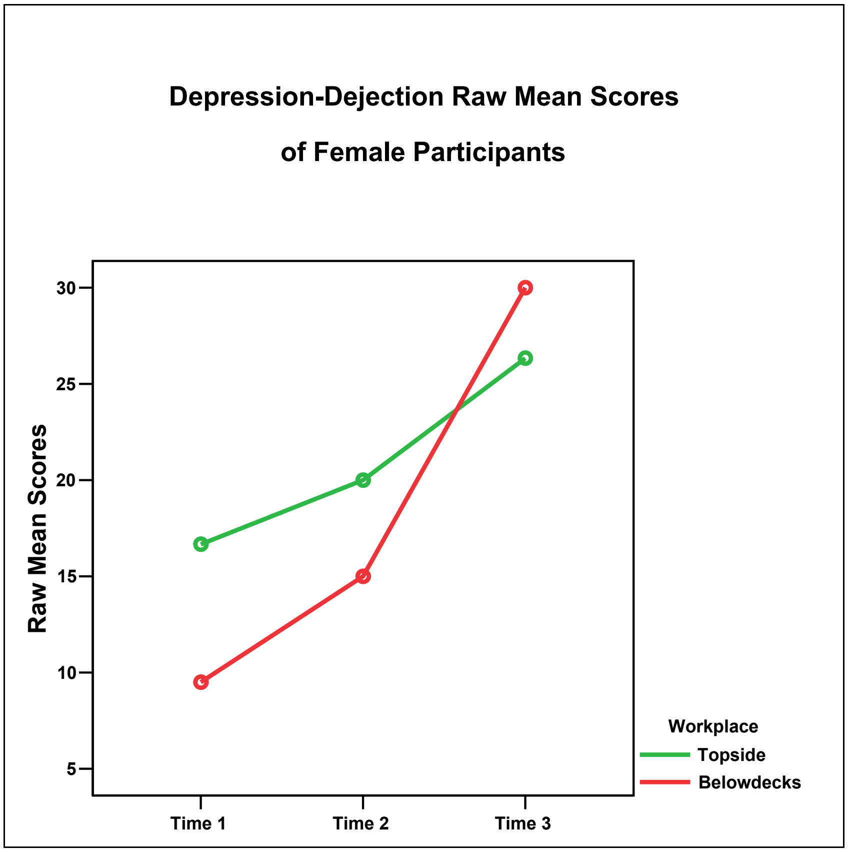


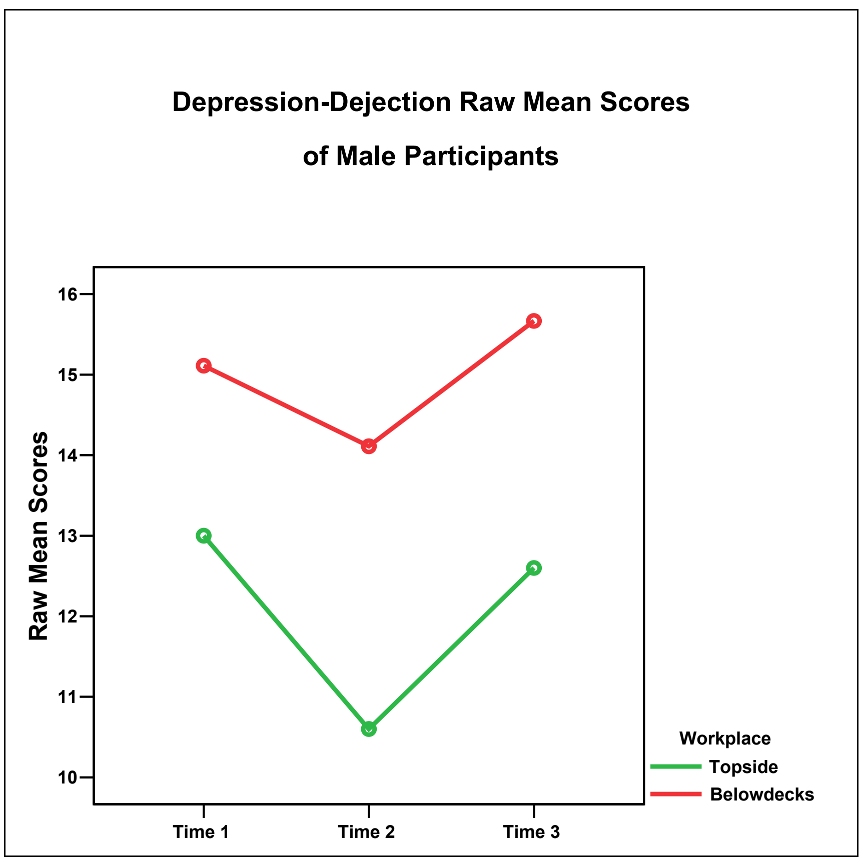

Tension-Anxiety Raw Mean Scores
of Female Particpants
Raw Mean Scores
19
18
17
16
15
14
13
12
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

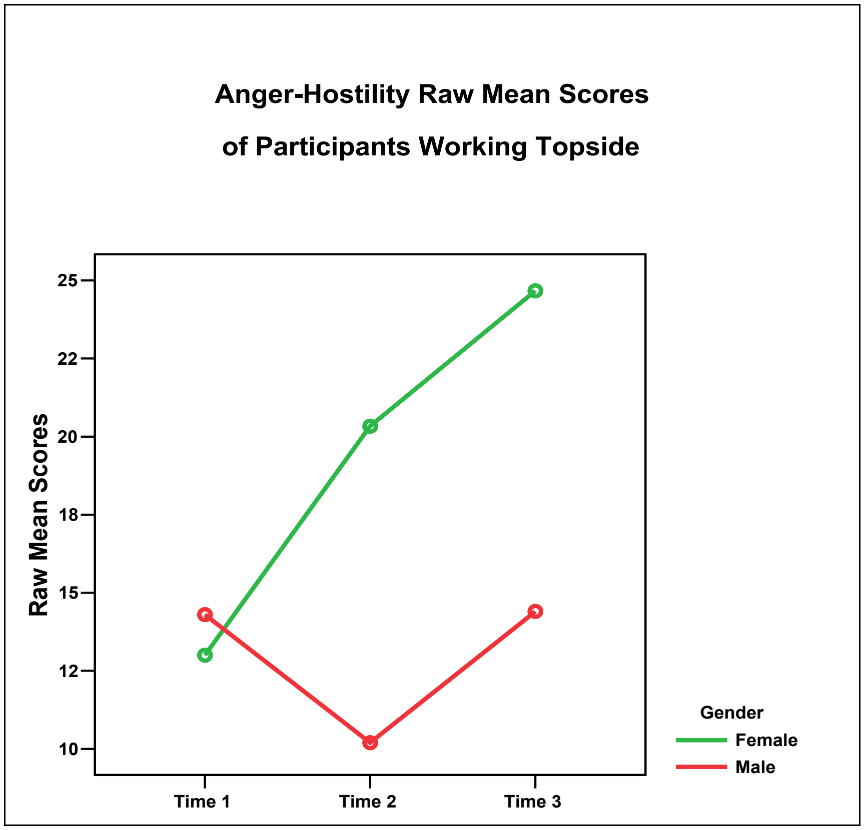

Tension-Anxiety Raw Mean Scores
of Male Participants
Raw Mean Scores
13
12
11
10
9
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

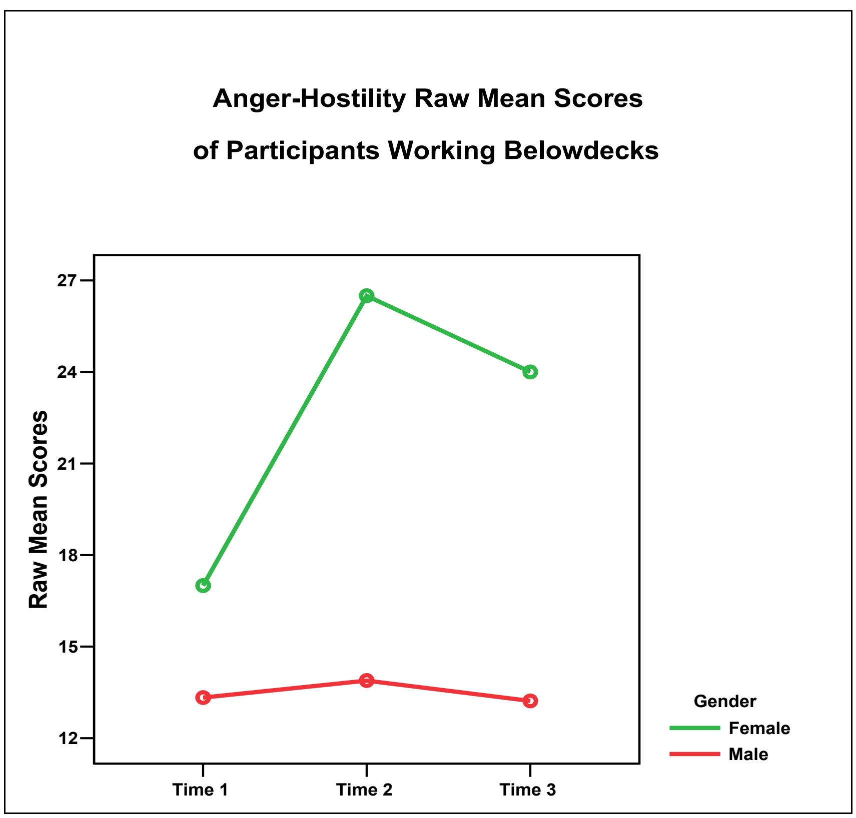

Depression-Dejection Raw Mean Scores
of Participants Working Topside
Raw Mean Scores
25
20
15
10
Time 1
Time 2
Time 3
Gender
Female
Male

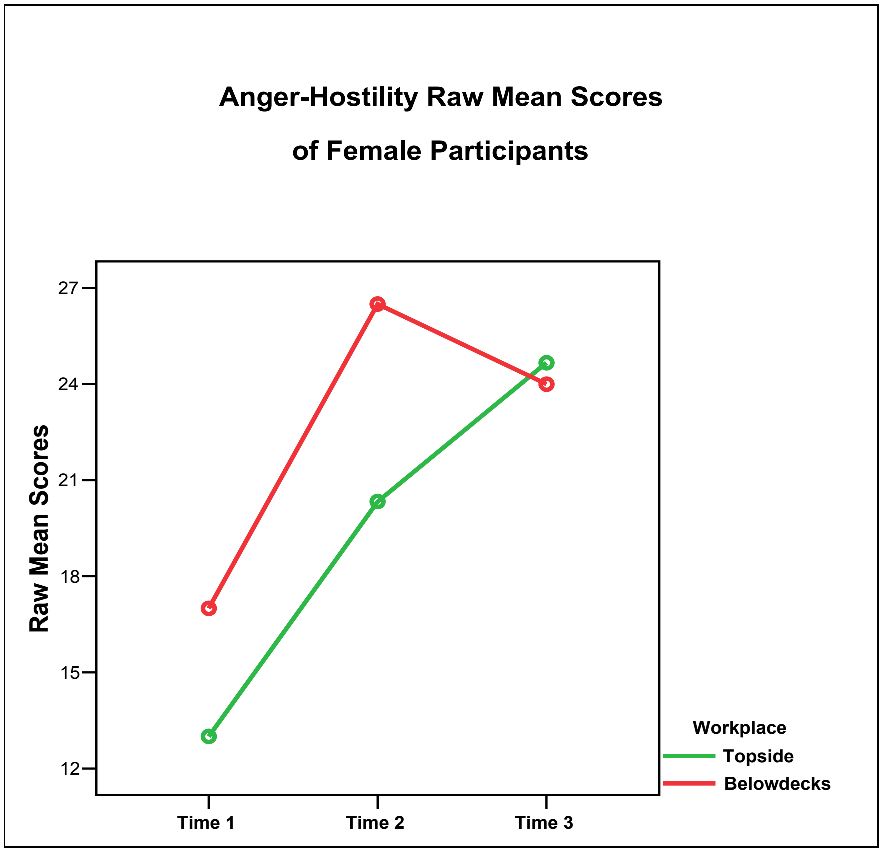

Depression-Dejection Raw Mean Scores
of Participants Working Belowdecks
Raw Mean Scores
30
25
20
15
10
5
Time 1
Time 2
Time 3
Gender
Female
Male

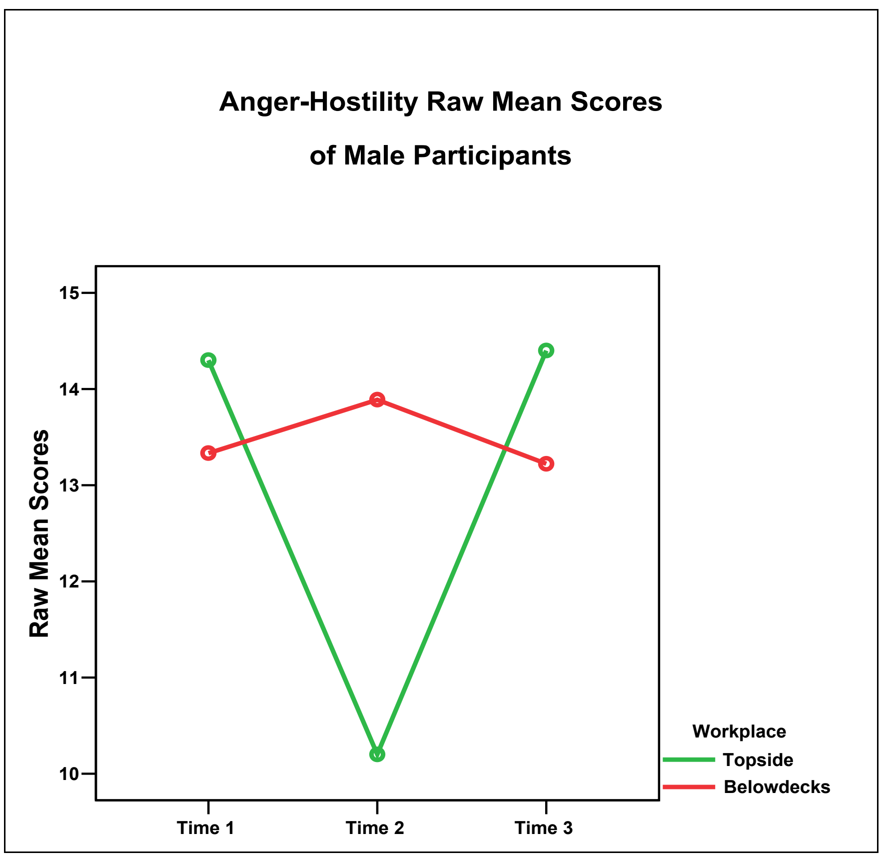

Depression-Dejection Raw Mean Scores
of Female Participants
Raw Mean Scores
30
25
20
15
10
5
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

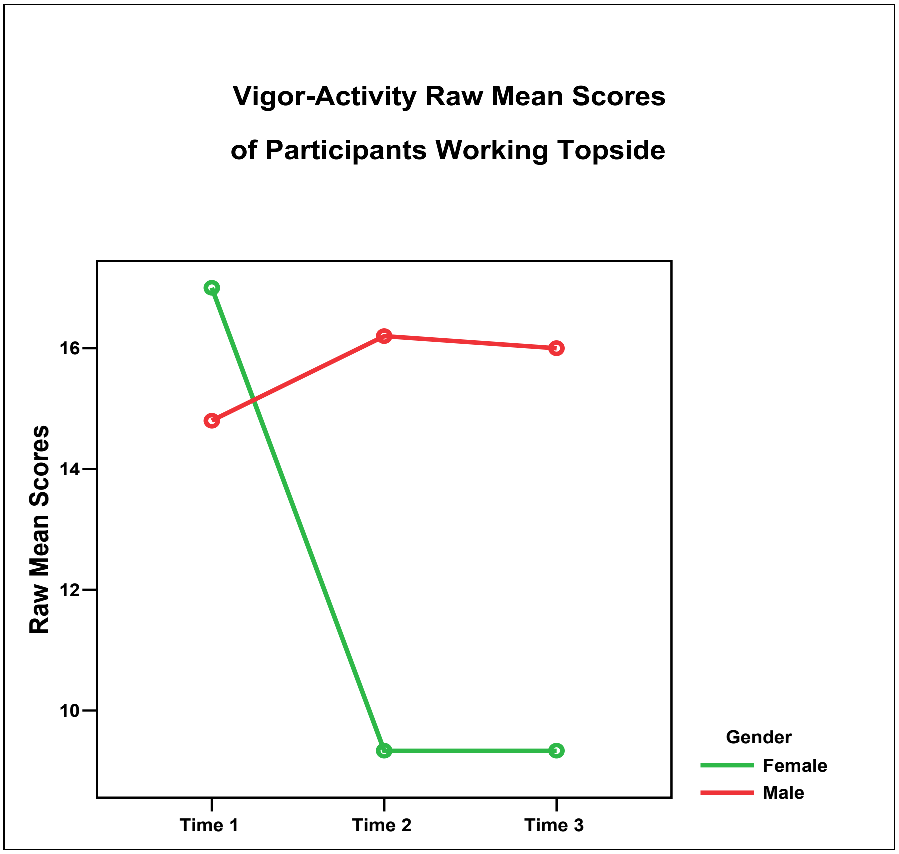

Depression-Dejection Raw Mean Scores
of Male Participants
Raw Mean Scores
16
15
14
13
12
11
10
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks


Anger-Hostility Raw Mean Scores
of Participants Working Topside
Raw Mean Scores
25
22
20
18
15
12
10
Time 1
Time 2
Time 3
Gender
Female
Male

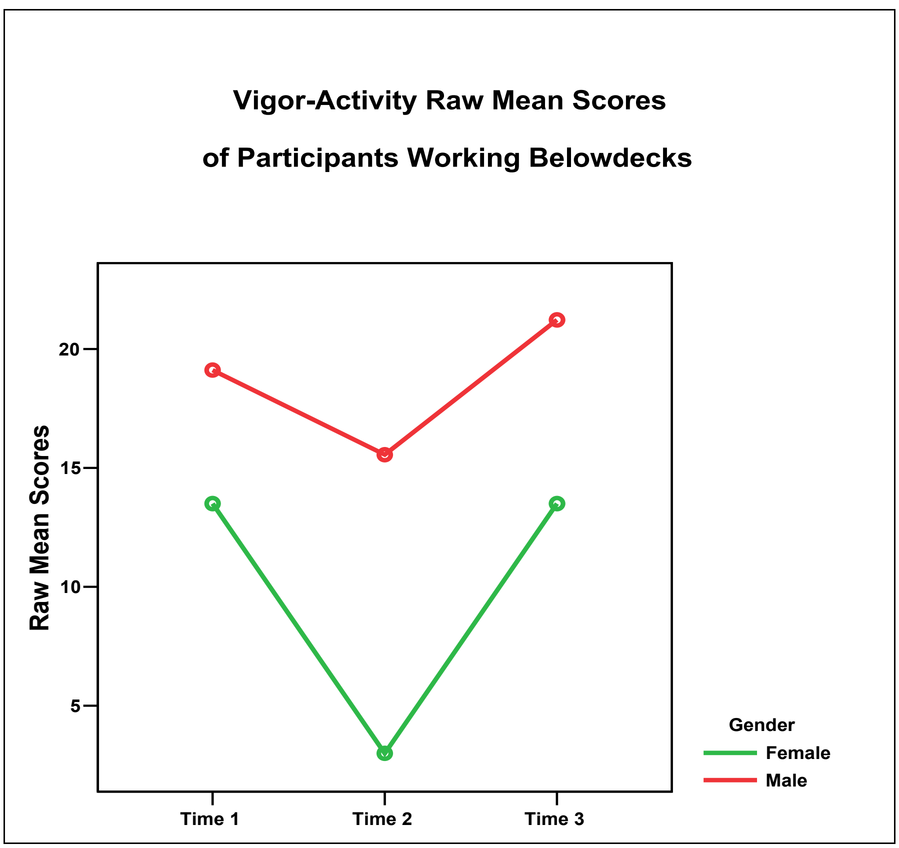

Anger-Hostility Raw Mean Scores
of Participants Working Belowdecks
Raw Mean Scores
27
24
21
18
15
12
Time 1
Time 2
Time 3
Gender
Female
Male


Anger-Hostility Raw Mean Scores
of Female Participants
Raw Mean Scores
27
24
21
18
15
12
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

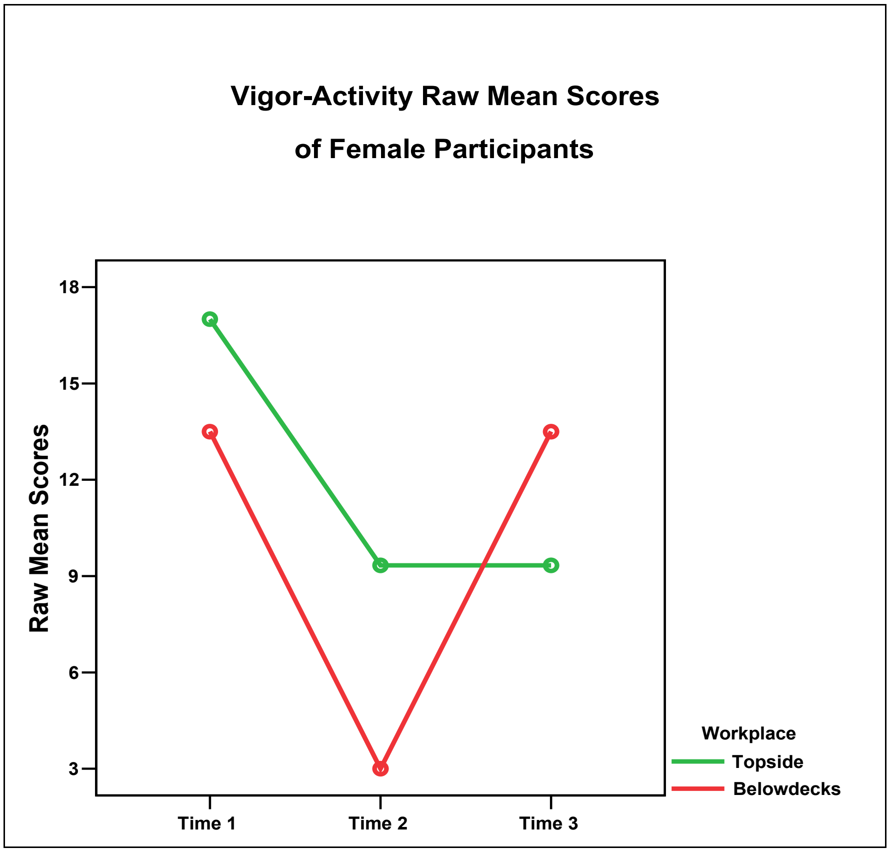

Anger-Hostility Raw Mean Scores
of Male Participants
Raw Mean Scores
15
14
13
12
11
10
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

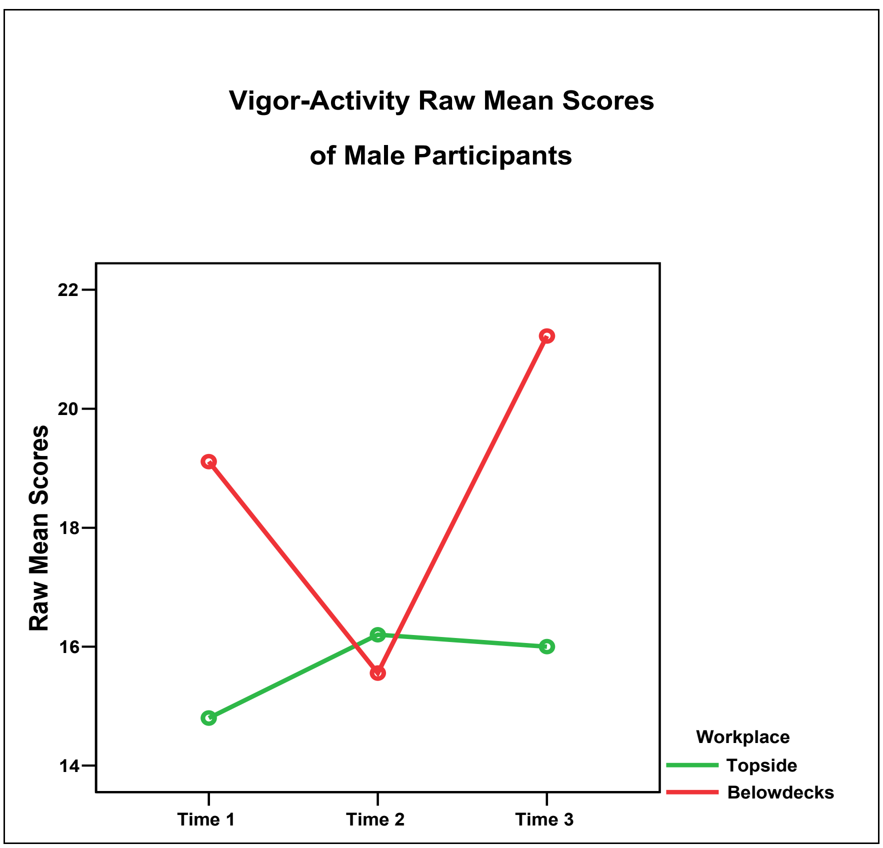


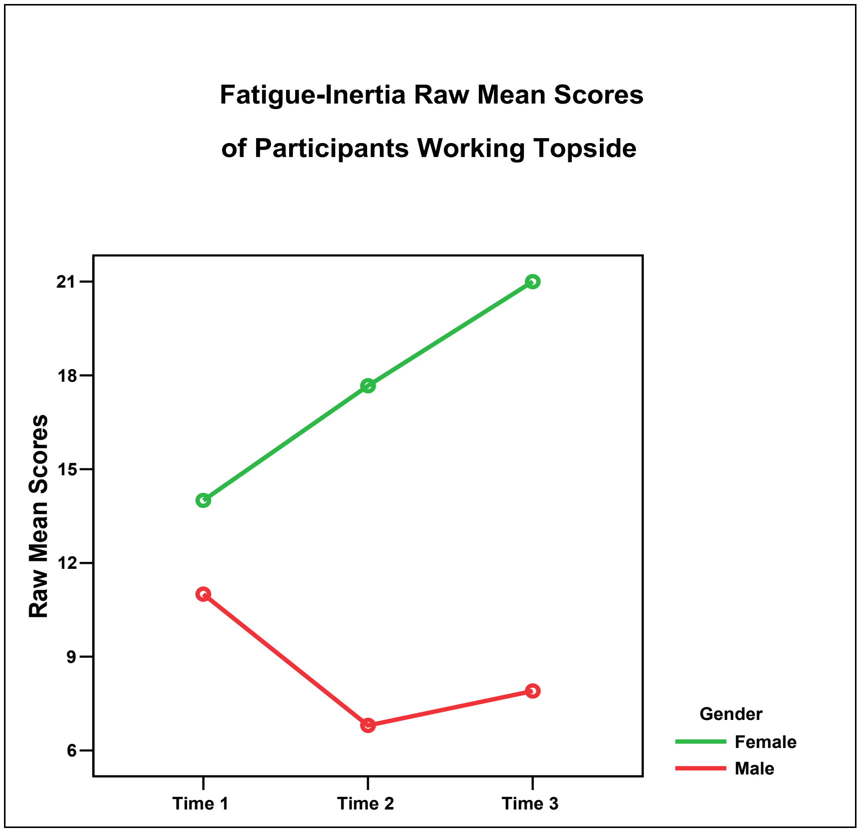
Vigor-Activity Raw Mean Scores
of Participants Working Topside
Raw Mean Scores
16
14
12
10
Time 1
Time 2
Time 3
Gender
Female
Male

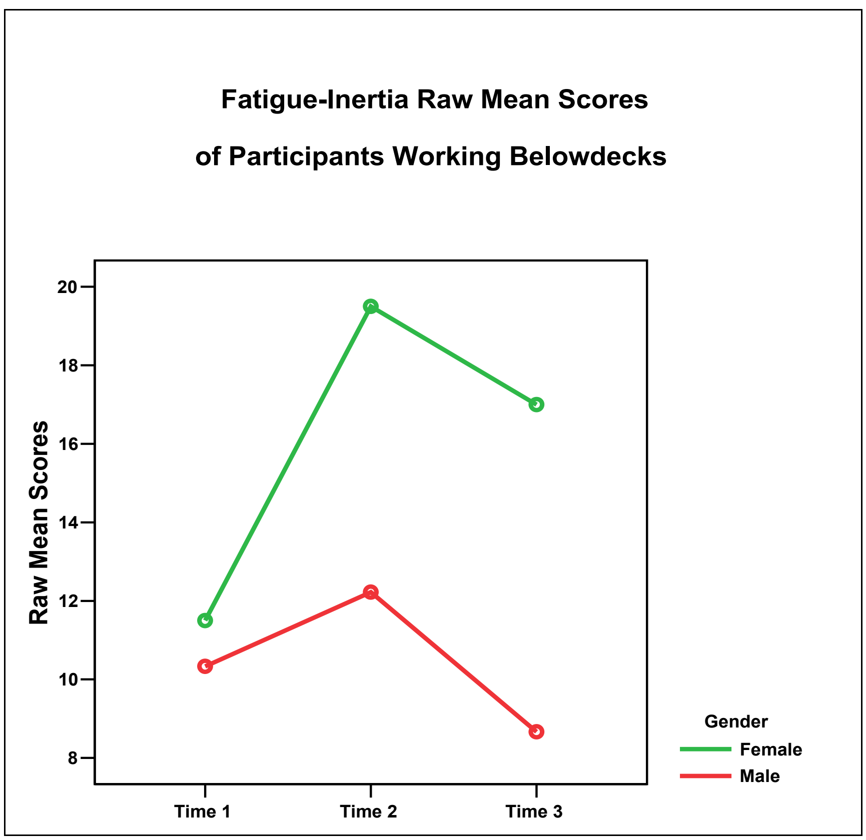


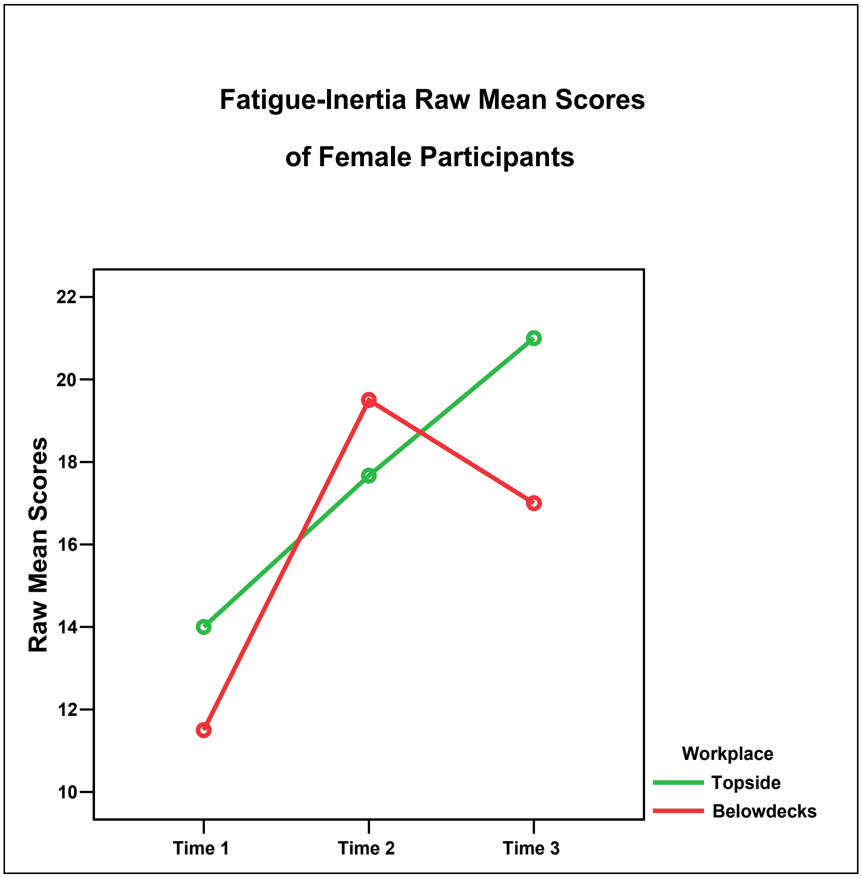
Vigor-Activity Raw Mean Scores
of Participants Working Belowdecks
Raw Mean Scores
20
15
10
5
Time 1
Time 2
Time 3
Gender
Female
Male

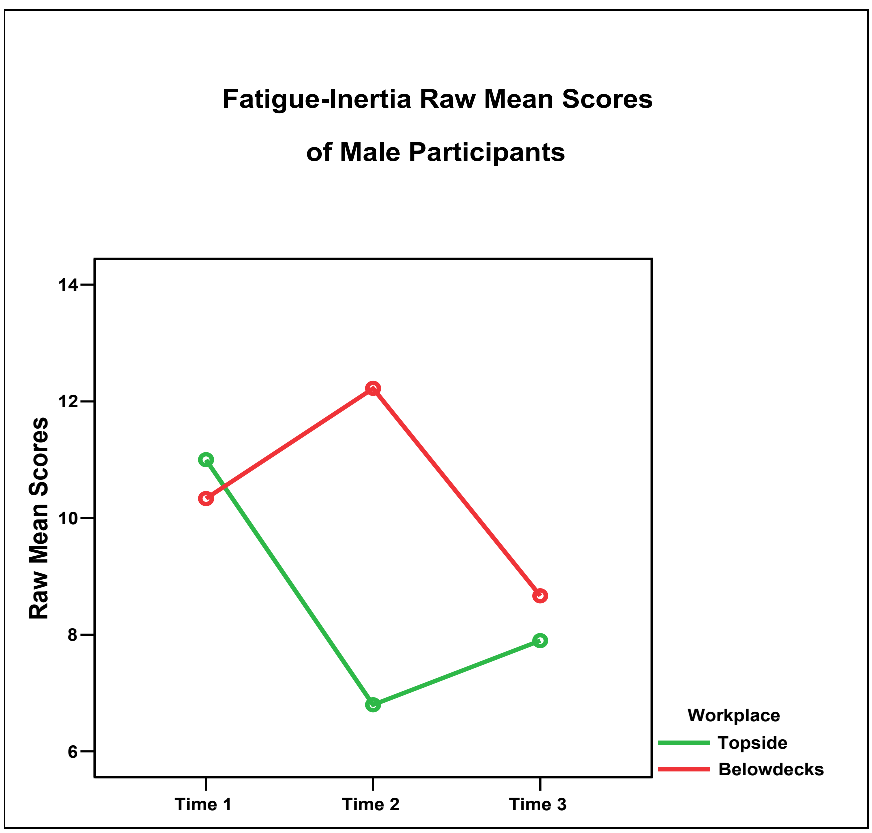

Vigor-Activity Raw Mean Scores
of Female Participants
Raw Mean Scores
18
15
12
9
6
3
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

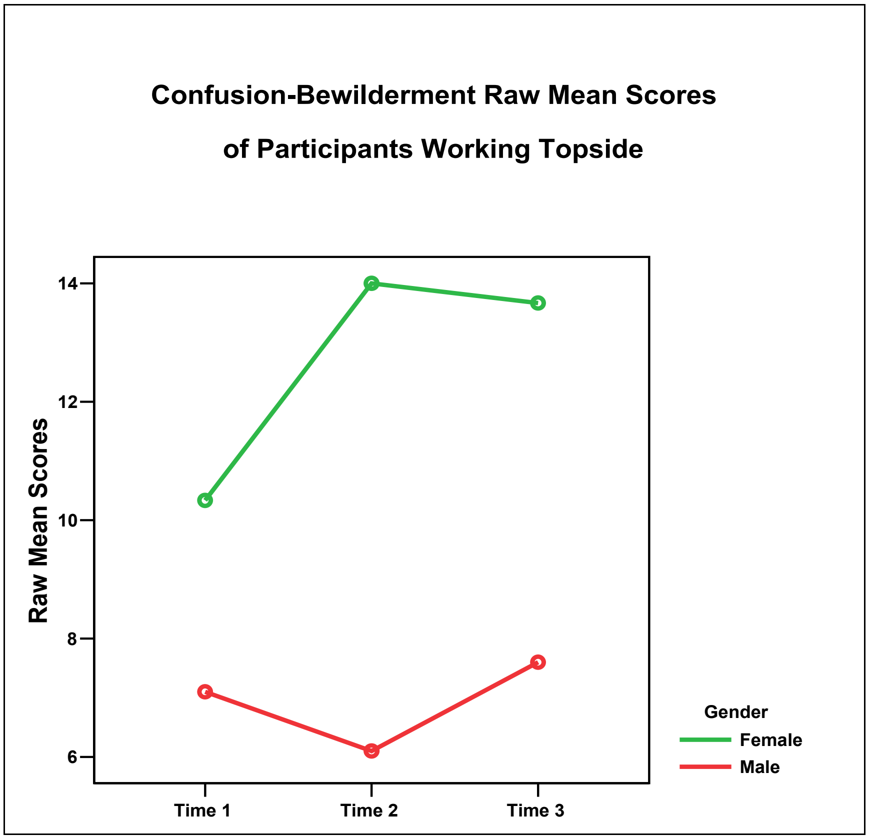

Vigor-Activity Raw Mean Scores
of Male Participants
Raw Mean Scores
22
20
18
16
14
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

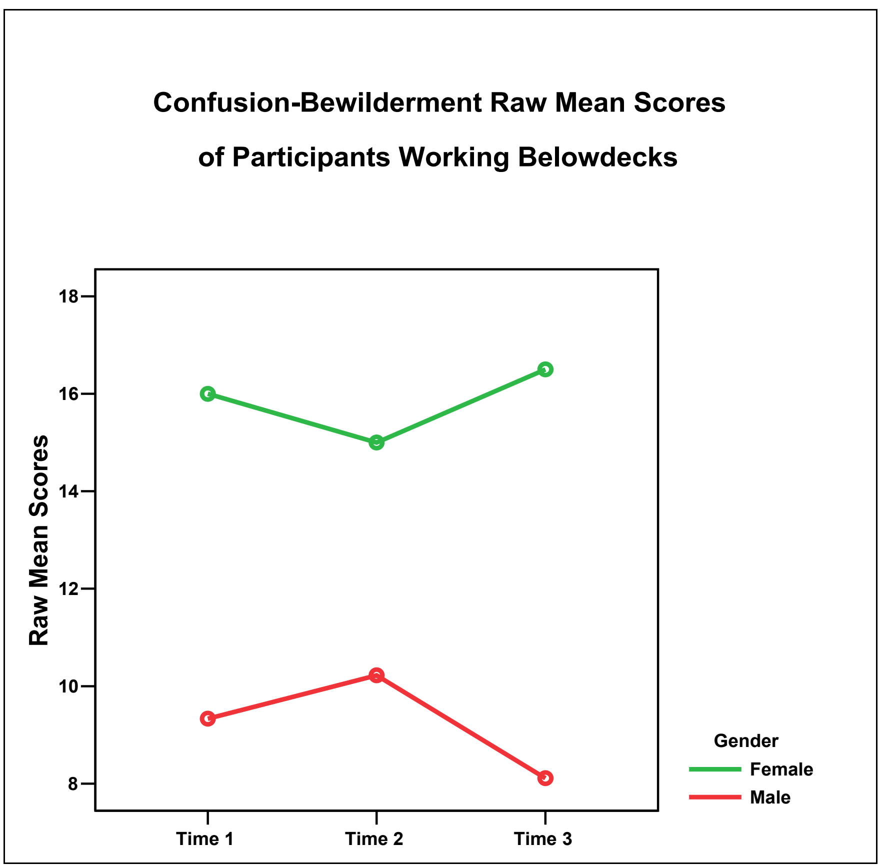

Fatigue-Inertia Raw Mean Scores
of Participants Working Topside
Raw Mean Scores
21
18
15
12
9
6
Time 1
Time 2
Time 3
Gender
Female
Male

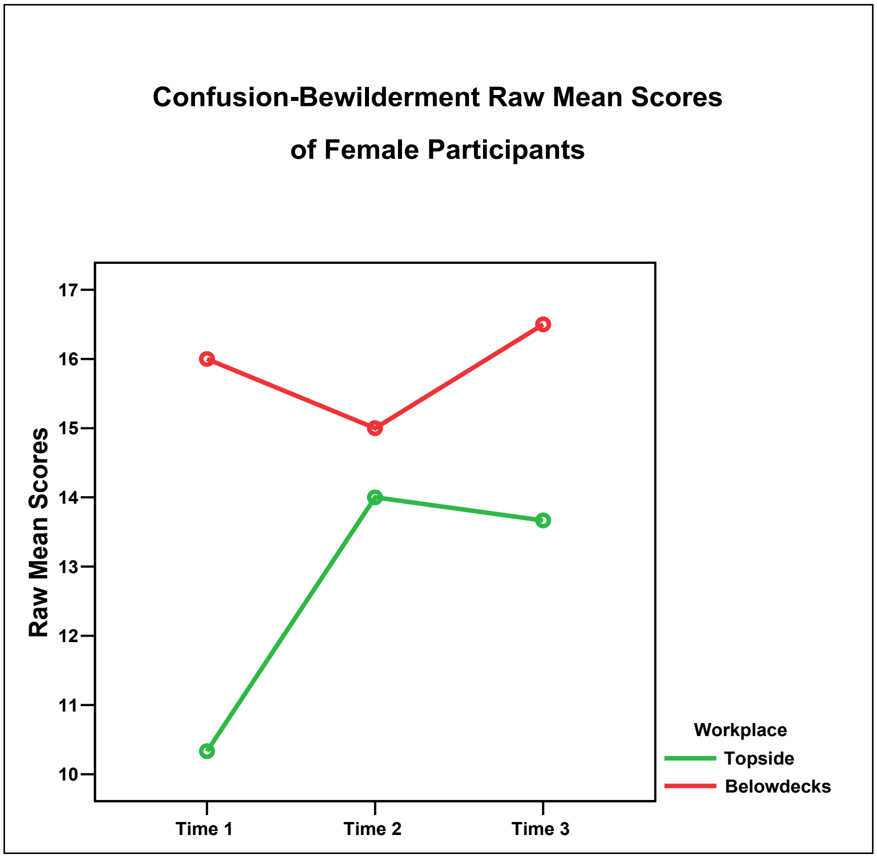

Fatigue-Inertia Raw Mean Scores
of Participants Working Belowdecks
Raw Mean Scores
20
18
16
14
12
10
8
Time 1
Time 2
Time 3
Gender
Female
Male

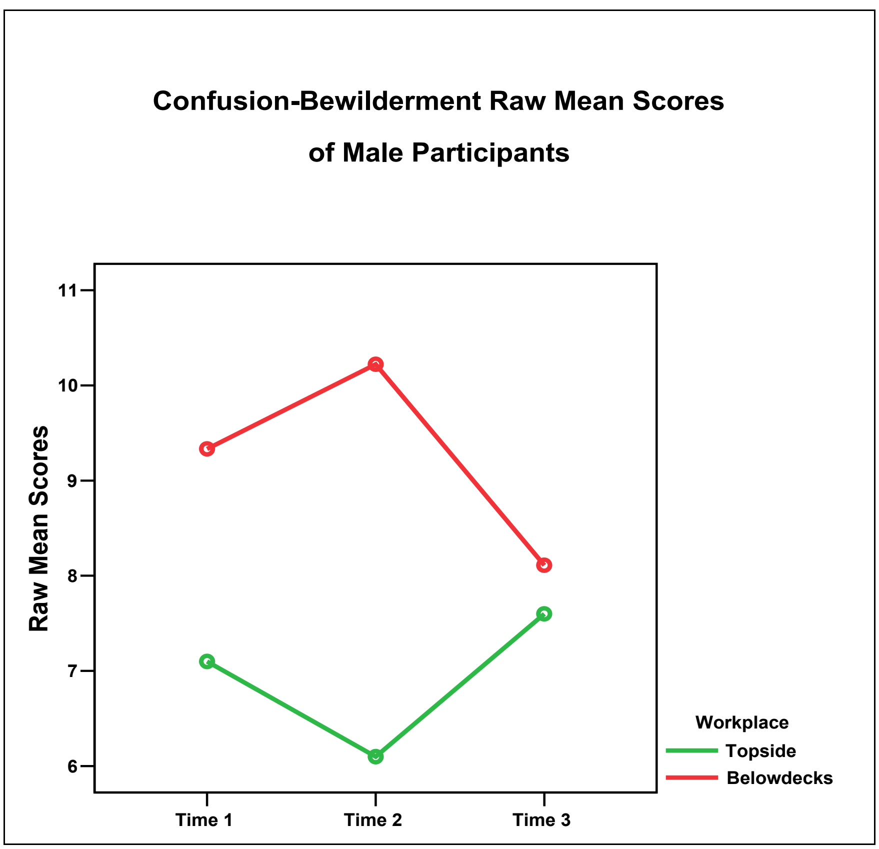

Fatigue-Inertia Raw Mean Scores
of Female Participants
Raw Mean Scores
22
20
18
16
14
12
10
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

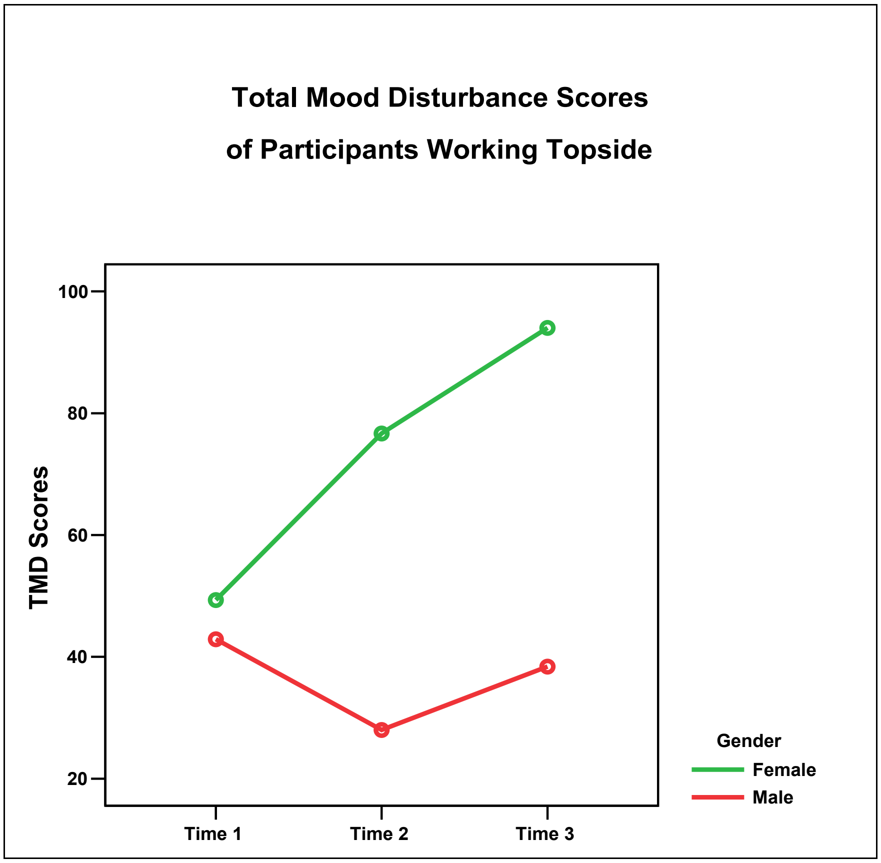

Fatigue-Inertia Raw Mean Scores
of Male Participants
Raw Mean Scores
14
12
10
8
6
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

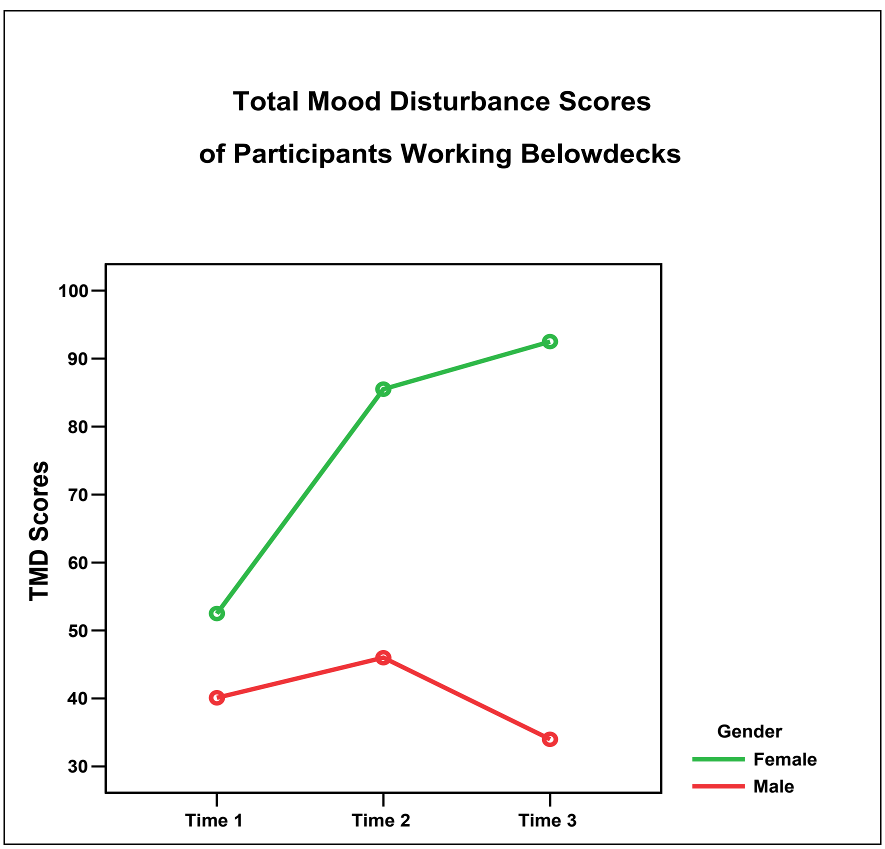

Confusion-Bewilderment Raw Mean Scores
of Participants Working Topside
Raw Mean Scores
14
12
10
8
6
Time 1
Time 2
Time 3
Gender
Female
Male

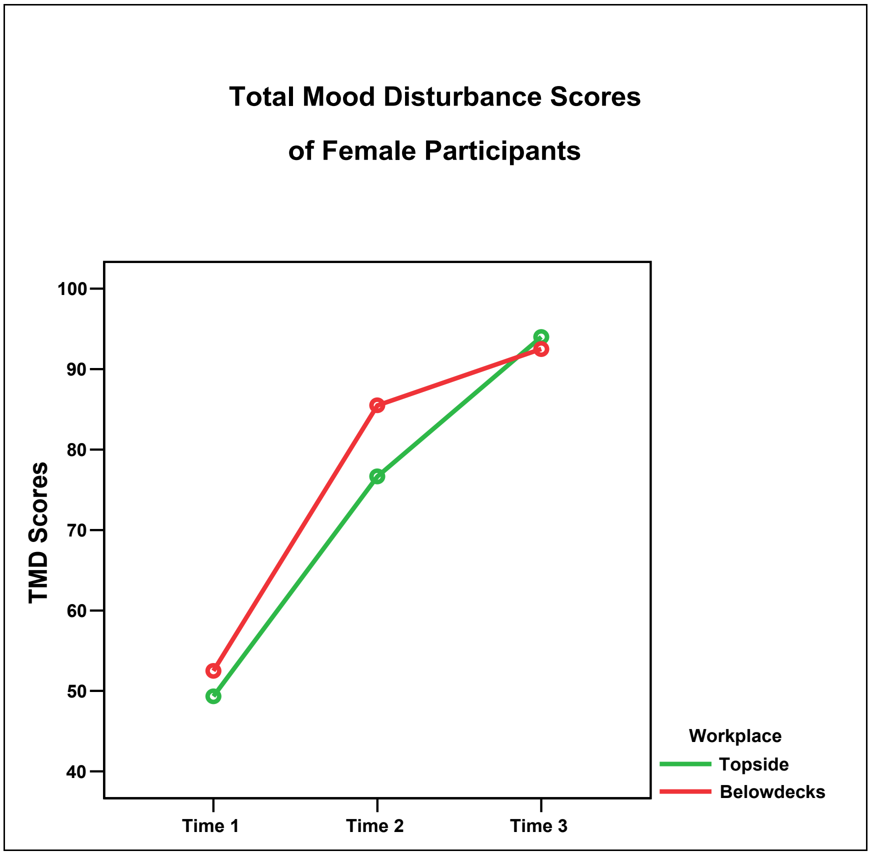

Confusion-Bewilderment Raw Mean Scores
of Participants Working Belowdecks
Raw Mean Scores
18
16
14
12
10
8
Time 1
Time 2
Time 3
Gender
Female
Male

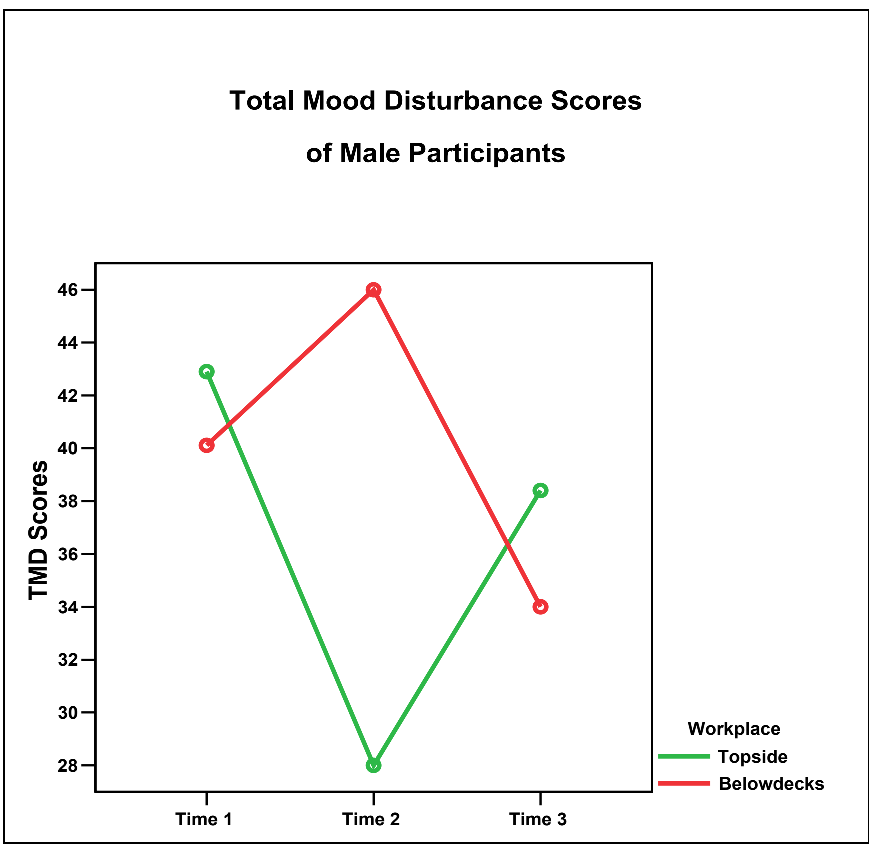

Confusion-Bewilderment Raw Mean Scores
of Female Participants
Raw Mean Scores
17
16
15
14
13
12
11
10
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks


Confusion-Bewilderment Raw Mean Scores
of Male Participants
Raw Mean Scores
11
10
9
8
7
6
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks


Total Mood Disturbance Scores
of Participants Working Topside
TMD Scores
100
80
60
40
20
Time 1
Time 2
Time 3
Gender
Female
Male


Total Mood Disturbance Scores
of Participants Working Belowdecks
TMD Scores
100
90
80
70
60
50
40
30
Time 1
Time 2
Time 3
Gender
Female
Male


Total Mood Disturbance Scores
of Female Participants
TMD Scores
100
90
80
70
60
50
40
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks


Total Mood Disturbance Scores
of Male Participants
TMD Scores
46
44
42
40
38
36
34
32
30
28
Time 1
Time 2
Time 3
Workplace
Topside
Belowdecks

APPENDIX K. DESCRIPTIVE STATISTICS OF GENDER AND WORKPLACE OVER THREE REPEATED ADMINISTRATIONS OF POMS SCORES

Tension-Anxiety

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	12.3333	8.08290	3
		Belowdecks	12.0000	11.31371	2
		Total	12.2000	8.04363	5
	Male	Topside	12.3000	3.88873	10
		Belowdecks	11.1111	8.31331	9
		Total	11.7368	6.21684	19
	Total	Topside	12.3077	4.71495	13
		Belowdecks	11.2727	8.25943	11
		Total	11.8333	6.44486	24
Time 2	Female	Topside	14.0000	9.53939	3
		Belowdecks	12.5000	.70711	2
		Total	13.4000	6.80441	5
	Male	Topside	10.5000	6.43342	10
		Belowdecks	11.1111	8.96444	9
		Total	10.7895	7.51723	19
	Total	Topside	11.3077	6.96879	13
		Belowdecks	11.3636	8.04081	11
		Total	11.3333	7.31090	24
Time 3	Female	Topside	17.6667	8.73689	3
		Belowdecks	18.5000	9.19239	2
		Total	18.0000	7.71362	5
	Male	Topside	11.9000	4.67737	10
		Belowdecks	9.5556	8.48692	9
		Total	10.7895	6.66316	19
	Total	Topside	13.2308	5.96034	13
		Belowdecks	11.1818	8.89739	11
		Total	12.2917	7.35130	24

Depression-Dejection

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	16.6667	9.86577	3
		Belowdecks	9.5000	9.19239	2
		Total	13.8000	9.23038	5
	Male	Topside	13.0000	9.64941	10
		Belowdecks	15.1111	14.06631	9
		Total	14.0000	11.64760	19
	Total	Topside	13.8462	9.41494	13
		Belowdecks	14.0909	13.11072	11
		Total	13.9583	10.99992	24
Time 2	Female	Topside	20.0000	10.81665	3
		Belowdecks	15.0000	1.41421	2
		Total	18.0000	8.15475	5
	Male	Topside	10.6000	8.00278	10
		Belowdecks	14.1111	14.99537	9
		Total	12.2632	11.62775	19
	Total	Topside	12.7692	9.19378	13
		Belowdecks	14.2727	13.42454	11
		Total	13.4583	11.09241	24
Time 3	Female	Topside	26.3333	19.21805	3
		Belowdecks	30.0000	15.55635	2
		Total	27.8000	15.78607	5
	Male	Topside	12.6000	6.31049	10
		Belowdecks	15.6667	14.67992	9
		Total	14.0526	10.87031	19
	Total	Topside	15.7692	11.30010	13
		Belowdecks	18.2727	15.17294	11
		Total	16.9167	12.97461	24

Anger-Hostility

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	13.0000	9.64365	3
		Belowdecks	17.0000	5.65685	2
		Total	14.6000	7.70065	5
	Male	Topside	14.3000	9.33393	10
		Belowdecks	13.3333	12.51000	9
		Total	13.8421	10.64719	19
	Total	Topside	14.0000	9.00925	13
		Belowdecks	14.0000	11.42804	11
		Total	14.0000	9.95643	24
Time 2	Female	Topside	20.3333	15.53491	3
		Belowdecks	26.5000	2.12132	2
		Total	22.8000	11.54123	5
	Male	Topside	10.2000	9.90847	10
		Belowdecks	13.8889	14.16373	9
		Total	11.9474	11.90926	19
	Total	Topside	12.5385	11.55866	13
		Belowdecks	16.1818	13.67346	11
		Total	14.2083	12.42711	24
Time 3	Female	Topside	24.6667	18.14754	3
		Belowdecks	24.0000	1.41421	2
		Total	24.4000	12.85690	5
	Male	Topside	14.4000	10.05761	10
		Belowdecks	13.2222	14.01586	9
		Total	13.8421	11.75804	19
	Total	Topside	16.7692	12.28925	13
		Belowdecks	15.1818	13.28020	11
		Total	16.0417	12.49514	24

Vigor-Activity

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	17.0000	1.73205	3
		Belowdecks	13.5000	17.67767	2
		Total	15.6000	9.12688	5
	Male	Topside	14.8000	2.09762	10
		Belowdecks	19.1111	6.17342	9
		Total	16.8421	4.90196	19
	Total	Topside	15.3077	2.17503	13
		Belowdecks	18.0909	8.17869	11
		Total	16.5833	5.79292	24
Time 2	Female	Topside	9.3333	5.13160	3
		Belowdecks	3.0000	1.41421	2
		Total	6.8000	5.06952	5
	Male	Topside	16.2000	4.75628	10
		Belowdecks	15.5556	8.53099	9
		Total	15.8947	6.61559	19
	Total	Topside	14.6154	5.51571	13
		Belowdecks	13.2727	9.17705	11
		Total	14.0000	7.27712	24
Time 3	Female	Topside	9.3333	5.03322	3
		Belowdecks	13.5000	7.77817	2
		Total	11.0000	5.74456	5
	Male	Topside	16.0000	4.78423	10
		Belowdecks	21.2222	6.37922	9
		Total	18.4737	6.05868	19
	Total	Topside	14.4615	5.47137	13
		Belowdecks	19.8182	6.95440	11
		Total	16.9167	6.63926	24

Fatigue-Inertia

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	14.0000	4.35890	3
		Belowdecks	11.5000	13.43503	2
		Total	13.0000	7.51665	5
	Male	Topside	11.0000	5.27046	10
		Belowdecks	10.3333	4.21307	9
		Total	10.6842	4.67918	19
	Total	Topside	11.6923	5.07255	13
		Belowdecks	10.5455	5.69848	11
		Total	11.1667	5.28054	24
Time 2	Female	Topside	17.6667	4.04145	3
		Belowdecks	19.5000	2.12132	2
		Total	18.4000	3.20936	5
	Male	Topside	6.8000	4.61399	10
		Belowdecks	12.2222	6.92419	9
		Total	9.3684	6.30000	19
	Total	Topside	9.3077	6.43408	13
		Belowdecks	13.5455	6.89005	11
		Total	11.2500	6.84772	24
Time 3	Female	Topside	21.0000	4.00000	3
		Belowdecks	17.0000	5.65685	2
		Total	19.4000	4.56070	5
	Male	Topside	7.9000	4.79467	10
		Belowdecks	8.6667	5.93717	9
		Total	8.2632	5.22645	19
	Total	Topside	10.9231	7.27394	13
		Belowdecks	10.1818	6.53939	11
		Total	10.5833	6.80739	24

Confusion-Bewilderment

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	10.3333	3.21455	3
		Belowdecks	16.0000	8.48528	2
		Total	12.6000	5.72713	5
	Male	Topside	7.1000	4.48330	10
		Belowdecks	9.3333	4.97494	9
		Total	8.1579	4.72891	19
	Total	Topside	7.8462	4.33678	13
		Belowdecks	10.5455	5.85429	11
		Total	9.0833	5.15766	24
Time 2	Female	Topside	14.0000	7.21110	3
		Belowdecks	15.0000	.00000	2
		Total	14.4000	5.12835	5
	Male	Topside	6.1000	4.55705	10
		Belowdecks	10.2222	6.24055	9
		Total	8.0526	5.67131	19
	Total	Topside	7.9231	6.02026	13
		Belowdecks	11.0909	5.90685	11
		Total	9.3750	6.05635	24
Time 3	Female	Topside	13.6667	10.01665	3
		Belowdecks	16.5000	7.77817	2
		Total	14.8000	8.22800	5
	Male	Topside	7.6000	4.14193	10
		Belowdecks	8.1111	7.02575	9
		Total	7.8421	5.53035	19
	Total	Topside	9.0000	6.05530	13
		Belowdecks	9.6364	7.55345	11
		Total	9.2917	6.63639	24

Total Mood Disturbance

	Gender	Workplace	Mean	Std. Deviation	N
Time 1	Female	Topside	49.3333	34.26855	3
		Belowdecks	52.5000	65.76093	2
		Total	50.6000	40.88154	5
	Male	Topside	42.9000	29.02662	10
		Belowdecks	40.1111	43.11741	9
		Total	41.5789	35.34955	19
	Total	Topside	44.3846	28.90657	13
		Belowdecks	42.3636	44.10051	11
		Total	43.4583	35.81350	24
Time 2	Female	Topside	76.6667	51.28678	3
		Belowdecks	85.5000	3.53553	2
		Total	80.2000	36.62922	5
	Male	Topside	28.0000	33.76060	10
		Belowdecks	46.0000	50.70010	9
		Total	36.5263	42.39807	19
	Total	Topside	39.2308	41.81737	13
		Belowdecks	53.1818	48.09328	11
		Total	45.6250	44.36686	24
Time 3	Female	Topside	94.0000	62.98412	3
		Belowdecks	92.5000	44.54773	2
		Total	93.4000	49.80261	5
	Male	Topside	38.4000	25.83796	10
		Belowdecks	34.0000	53.01651	9
		Total	36.3158	39.85119	19
	Total	Topside	51.2308	41.90894	13
		Belowdecks	44.6364	54.83662	
		Total	48.2083	47.27623	24

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